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GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

ALFRED R. C. SELWYN, LL.D., F.R.S., DIRECTOR.

REPORT OF PROGRESS

FOR

1880-81-82.

PUBLISHED BY AUTHORITY.

Montreal:
DAWSON BROTHERS.

1883.

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GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

REPORTS

OF

EXPLORATIONS AND SURVEYS.

1880-81-82.

To THE RIGHT HONORABLE

SIR JOHN A. MACDONALD, P.C., K.C.B.

Minister of the Interior.

SIR,—I have the honor to submit for the information of His Excellency the Governor-General in Council, the customary Annual Report, relating to the progress of the Geological and Natural History Survey of Canada. These reports embrace a part only of the work of the three seasons named.

I have the honor to be,

Sir,

Your most obedient servant,

ALFRED R. C. SELWYN.

OTTAWA, May, 1883.

GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

ALFRED R. C. SELWYN, LL.D., F.R.S., DIRECTOR.

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ERRATA.

REPORT A. (IV.)

Page 4 A, *4th line from bottom, for* " page 34," *read* " page 434."

REPORT B. (V.)

Page 14 B, *10th line from top, for* " page 49 C," *read* " page 49 G."

REPORT C. (VI.)

Page 15 C, *14th line from bottom, for* " page 33 H," *read* " page 23H."

REPORT DD. (VIII.)

Page 2 DD, 1, 4, 14 *lines, &c., from top, for* " Breche á Manon." *read* " Brèche à Manon.'
" 2 DD, *8th line from top, for* " Branpits," *read* " Beaufils."
" 3 DD, *14th line from bottom, for* " Mr. Lord," *read* " Mr. Low."
" 7 DD, *16th line, for* " *Cordaites angustifolia,*" *read* " *Cordaites angustifolius.*"
" 7 DD, *44th line, for* " *Orthis aurelia* (?)" *read* " *Orthis Aurelia* (?)
" 8 DD, *7th line, for* " *Illoenus,*" *read* " *Illaenus.*"
" 8 DD, *16th line from top, for* " Barry Cape," *read* " Barré Cape."
" 10 DD, *4th line from top, for* " p.p. 88–86," *read* " 880–86."
" 11 DD, *22nd line from top, for* " Mr. Albert," *read* " Mt. Albert."
" 13 DD, *30th line, for* " *Modiolopsis Tethys,*" *read* " *Sanguinolites Tethys.*"
" 14 DD, *2nd line, for* " *Spirifera Cycloptera,*" *read* " *Spirifera cycloptera.*"
" 14 DD, *17th line, for* " *Phoetus phocion,*" *read* " *Proetus Phocion.*"
" 17 DD, *21st line, for* " *Graptolithus flexilis,*" *read* " *Dichograptus flexilis.*"
" 18 DD, *16th line from top, for* " Gros Rivière," *read* " Grosse Rivière."
" 19 DD, *5th* and *7th line from bottom, for* " Petite Cap," *read* " Petit Cap."
" 21 DD, *2nd line from top, for* " p. 69," *read* " p. 49."
" 21 DD, *2nd line from bottom, for* " Gros Mâule," *read* " Gros Mâle."
" 22 DD, *12th, 25th from top* and *3rd from bottom,* same correction.
" 22 DD, *4th line from bottom, for* " Abour Brook," *read* " à Rebours Brook."
" 24 DD, *14th* and *25th from top, for* " Ruisseau Vallée," *read* " Ruisseau à Vallée."
" 25 DD, *bottom, for* " *Graptolithus bifidus,*" read " *Didymograptus bifidus.*"
" 25 DD, *bottom, for* " *Graptolithus pennatulus,*" read " *Didymograptus pennatulus.*"
" 25 DD, *bottom, for* " *Graptolithus bryonoides,*" read " *Tetragraptus bryonoides.*"
" 25 DD, *bottom, for* " *Graptolithus fruticosus,*" read " *Tetragraptus fruticosus.*"
" 25 DD, *bottom, for* " *Graptolithus Richardsoni,*" read " *Dichograptus Richardsoni.*"
" 28 DD, *9th* and *15th line from top,* same correction.
" 28 DD, *13th line from top, for* " Anse du Tour," *read* " Anse du Four."
" 28 DD, *26th line from top, for* " *Dicthograptus flexilis,*" read " *Dichograptus flexilis.*"
" 28 DD, *34th line from top, for* " *Dicthograptus rigidus,*" read " *Dichograptus rigidus.*'
" 30 DD, *3rd line from top, for* " *Diplograptus annectaus,*" read " *Didymograptus annectans*"

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Page 37 GG, *6th line from top, for* " p. 52," *read* " p. 52 G.G."

SUMMARY REPORTS

OF THE

OPERATIONS OF THE GEOLOGICAL CORPS

TO 31ST DECEMBER, 1881,

AND

TO 31ST DECEMBER, 1882.

BY

ALFRED R. C. SELWYN, LL.D., F.R.S.,

DIRECTOR OF THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

1881.

Removal to Ottawa.

The most important event in connection with this branch of the Department during the year, has been the removal from Montreal to Ottawa of the museum, and headquarters of the Survey, in accordance with the provisions of the Act, 40 Vict., Cap. 9, Sec. 7.

This work has necessarily occupied the greater part of the time and attention of the Director, and the museum staff, during the entire year. Most of the specimens are now unpacked and arranged in the cases, and the new museum rooms have been open to visitors since the 1st December. A very large amount of work, however, in numbering, labelling and cataloguing the specimens remains to be accomplished.

The total cost of the removal up to 31st December, has been $10,012.57, without taking into account the salaries of those members of the corps, the most of whose time during the year has been devoted to this work. To meet this expenditure a supplementary vote of $5,000 was granted, and the balance has been defrayed out of the general appropriation for the Survey.

The total number and weight of packages forwarded from Montreal between the months of November, 1880, and May, 1881, was 1,729 boxes, 101 barrels, 162 miscellaneous packages—gross weight, 282,585 lbs. in 1,992 packages. These comprised minerals, rocks, fossils, natural history specimens, books, office furniture and museum cases, &c. This work was conducted by Messrs. Weston, Willimott and White, assisted by Messrs. Broadbent, Curry, Holmes, Ward and White, jun.

The services of Mr. Broadbent have been retained to assist in the work of unpacking and re-arranging the specimens.

Archæological collections.

A very large collection of the manufactures of the Pacific Coast Indians, including implements of the chase, weapons, domestic utensils clothing, ornaments, &c., has been placed in the museum, and is now on view. This interesting and valuable collection has been acquired by the Indian Branch of the Department, through the exertion of Dr. Powell, in British Columbia, at a cost of $1,232.54, and it would be very desirable to obtain an equally complete collection of the manufactures of the tribes east of the Rocky Mountains and around Hudson's Bay. Such collections will eventually constitute the only historical record of the habits, manners and customs of the early inhabitants of the Dominion, and should therefore be well represented in the National Museum.

The time when it will be no longer possible to acccomplish this is at hand, and suggests the necessity of prompt action in the matter, unless Canada is to be forever dependent upon the museums of the United States for information relating to the life history of her own aboriginal races.

Recent Natural History collections.

During several years past considerable collections in recent natural history have been made by various members of the geological corps. These have been noticed in the annual reports, but there being no space available for their exhibition, they have, to a large extent, been placed in the custody of the McGill College and the Natural History Society of Montreal, with the understanding that if at any time required for the National Museum they would be transferred. In the Ottawa Museum one small room has now been set apart for recent natural history objects, and a section of the palæontological room for the exhibition of a very fine collection of shells loaned to the museum. There are already specimens on hand, or that could be purchased at a small expense, more than enough to occupy a much larger space than is at present available, and consequently if the recent natural history branch of the survey is to be carried out, additional accommodation for workrooms and exhibition space is now required. This could be effected at

Extension of the Museum.

a comparatively small cost ($8,000) by extending the two museum galleries at right angles to the present building, one side resting on the wall already built, and the other on columns and arches; no basement or ground floor would be required, and a very small outlay for foundations. Two large museum rooms with necessary work-rooms could in this way be provided, giving an internal space of 80 feet long and 29 feet wide on each floor, equal to 4,640 square feet.

Surveys.

The field work of the geological corps during the past season has extended from the Rocky Mountains to the Atlantic coast of Nova Scotia. The working parties have been distributed as follows:—

North-West Territories.
Basins of Hudson's Bay and Lake Superior.
Quebec.
New Brunswick.
Nova Scotia, including Cape Breton Island.

North-West Territories.

In the North-West Territories, Dr. G. M. Dawson, assisted by Mr. R. G. McConnell, examined a region extending from the 49th parallel to the Bow River, and from the Rocky Mountains eastward to the 111th meridian. The result of the work is summarized by Dr. Dawson as follows: —

"This region has long been known to contain coal and lignite, and the exploration has been conducted with special reference to these. The chief economic result of the survey has been to prove the great extent and importance of the western coal fields. It has been found that both coal and lignite occur at several different horizons in the Cretaceous system, and many localities yield fuel of excellent quality.

"Several facts of importance and interest, from a scientific point of view, have been ascertained, and a large collection of fossils has been secured. Canoe surveys have been made of the Bow, Belly and St. Mary Rivers, and extended running, and odometer surveys in all parts of the area above defined. Notes on the general economic features of the country were made during the summer, and meteorological observations recorded regularly. These latter will be continued by Mr. McConnell, who remains at Calgary during the winter, and will thus be in a position to secure important collections of plants, birds and other animals in the early spring before he can resume field operations. It is proposed to devote another season to work in the same region before the detailed report and map are prepared."

Dr. Dawson left Montreal for the season's work on the 10th May, and returned on the 15th November. Cost of exploration, $3,560.00.

A considerable amount, $1,131.00 of this expenditure, was incurred in the purchase of horses, waggons and other equipments which are now available for further work in the spring.

Basin of Hudson's Bay and Lake Superior.

Dr. Bell was requested to continue his exploration in the Lake Superior region, that portion being specially indicated which has hitherto been but little, or not at all examined, lying east and southeast of Michipicoten, and in which there is reason to anticipate the discovery of valuable mineral deposits, which the construction of the Canadian Pacific Railway might render of immediate economic value.

With this object in view, Michipicoten was selected by Dr. Bell as the starting point. Dr. Bell left Montreal on the 18th June, and Sault St. Marie on the 14th July for Michipicoten, arriving there on the 15th July.

The Michipicoten River was ascended to the height of land, and a number of rivers and lakes lying between lattitudes 48° and 49°50′ north, and longitudes 82°30′ and 85° west, chiefly at the sources of the Moose and Albany Rivers, were surveyed and explored, occupying till the 13th September, when the party returned to the mouth of the Michipicoten River and proceeded by steamer to Sault Ste. Marie, arriving there on the 14th September.

On the 16th September, Dr. Bell sent his assistant with equipment and canoes to Prince Arthur's Landing, instructing him to engage men and "proceed inland immediately," Dr. Bell returning to Collingwood to obtain provisions, &c. Subsequently Dr. Bell reports that, "besides examining the line of the railway from Fort William to Selkirk, a careful exploration was made of the Wabigoon and part of the Eagle Rivers, of Lake Wabigoon, and the chain of lakes leading from it to Eagle and Vermilion Lakes, the chain of lakes thence by way of Bell Lake to Whitefish Bay, including the shores of this bay; Shoal Lake, and of those portions of Lake of the Woods not previously examined. A good collection of the rocks of the Lake of the Woods region was secured."

The above work occupied from the 19th September to the first week in November, and Winnipeg was reached on the 7th of November. Dr. Bell remained in Manitoba till the 28th November, occupied "in collecting information as to building stones, lime, brick-clays, sand, 'mineral soap,' salt, the water supply, &c."

A detailed report will be prepared as usual for publication in the annual Report of the Survey.

The cost of this exploration was $2,734.18, and occupied from the 18th June to the 3rd December.

It having been considered desirable that Mr. Cochrane should remain in the country during the winter, arrangements for his doing so were made towards the close of the season 1880; and the Hudson's Bay Company kindly provided him with comfortable winter quarters at their post on Reindeer Lake. The greater part of the winter was spent in preparing maps of his previous season's explorations, as well as collecting and arranging such other information relating to that region, as was possible.

Owing to the ice on Reindeer Lake being unusually late in breaking up, much time was lost in the spring, and it was not till the 12th July the explorations were begun. After many careful inquiries from the Indians, and much information obtained from officers of the H. B. Co., it was decided to explore that portion of the country between Du Brochet Post on Reindeer Lake, and Fort Chipewyan, on Lake Athabasca, and to return from there to Winnipeg *via* the Athabasca and Churchill Rivers, and the numerous lakes through which these rivers pass, to Frog Portage, and thence to Lake Winnipeg by Cumberland House on the Lower Saskatchewan.

Considerable difficulty was experienced in securing the services of interpreters, guides and men for the rivers and lakes on the proposed route, as it is now seldom or never used.

The distance between the two extreme points, by the route followed, was found to be 625 miles, of which a continuous track survey was made.

On this route the somewhat remarkable feature of a lake forming a watershed is presented in the large lake known by the Indians as Hatchet Lake, but which is marked on all maps as Wollaston Lake. This lake discharges by two outlets of nearly equal volume, the one on the east side being an affluent of Hudson's Bay, and the other on the west side, of the Mackenzie River, passing through Athabasca Lake.

A track-survey of about 800 miles was made between Fort Chipewyan and Cumberland House, by Ile à la Crosse and Frog Portage. The detailed report of this exploration, extending over two seasons, will be prepared for publication in the annual Survey Report.

Mr. Cochrane returned to Winnipeg on the 20th November, and leaving there on the 28th, reached Ottawa on the 3rd December. The cost of this exploration has been $1,226.94 for two seasons.

Quebec.

Mr. Arthur Webster has continued the work of exploration and survey on the south side of the St. Lawrence, in the region bordering the states of Vermont, New Hampshire and Maine, with a view to connect the work of the geologists in these States, and the limits of the several formations as defined by them, with our own. He has also paid considerable attention to the question of the probable extent and location of the auriferous deposits in this region. The country is for the most part densely wooded and sparsely settled, and in consequence, close and accurate geological examination is a very tedious and difficult undertaking. Mr. Webster's work extended from the 5th May to the 6th November, and cost $1,051.87.

Mr. H. G. Vennor resigned his connection with the Survey on

30th April, 1881. During the seasons of 1877–1880, inclusive, Mr. Vennor was surveying and exploring in the Ottawa and Grenville phosphate region and in the counties of Argenteuil, Montcalm, Joliette and Berthier. Of the work of these four seasons, no detailed report or map has yet been furnished to the Director. It has, however, been promised, and the map, shewing the result of these four seasons' work, should be especially valuable.

Mr. Vennor's last report, embracing the work of 1875 and 1876, was published in the annual Report of the Survey for 1876–77.

New Brunswick.

In New Brunswick, explorations and surveys have been carried on during the year by Mr. Ells, over a large extent of country in the eastern and northern portion of the province, and have also extended to the southern shores of the peninsula of Gaspé, where surveys were made of the coast from Metapedia to Little Pabos, and of the rivers Cascapedia, Nouvelle, Bonaventure, Scaumenac, and Little Cascapedia, to a distance of about twenty miles from the sea.

In the counties of Northumberland, Kent, Westmoreland and Albert, geological examinations and topographical surveys were made to locate the outcrops of the coal seams in these counties, and to ascertain their probable economic value, and at the same time to connect the surveys in New Brunswick with those already made in Cumberland county, Nova Scotia. The work in the field occupied from the 25th April to the 12th November. Cost, $1,068.92.

In York county, on the north-east side of the River St. John, and extending into Carleton county, an area of about 7,000 square miles, was surveyed and examined by Mr. Wallace Broad. This work will afford the necessary data for the completion of the fourth quarter-sheet of the geological and topographical survey of southern New Brunswick. Mr. Broad spent two weeks in the Crown Lands office, Fredericton, making tracings of such plans as were connected with his work, or would afford additional information for the construction of the map. The field work commenced on the 25th April and terminated on the 12th November. Cost, $626.44.

Nova Scotia.

Mr. Hugh Fletcher has continued the work in Cape Breton, and reports as follows:—

"Early in the season a few days were spent in defining the limits of the Carboniferous and older formations in the neighborhood of Whycocomagh and the head of Lake Ainslie. Attention was then directed to the reported coal oil regions around this lake. No oil has yet been struck, and the money spent seems to have been thrown away. It is supposed that operations were commenced because of the finding of drops of petroleum which oozed from the dark, bituminous sandstone and shale on the lake shore.

The explorations were first carried on at the west side of the lake, where several stationary engines and derricks now lie idle and rusting; then bore holes were made on the east side, and also at McRae's bridge near Baddeck.

The sensational reports which have appeared in the Cape Breton and Boston newspapers, of the wonderful flow of petroleum from the wells, were altogether without foundation.

The very interesting region of the Mabou, Chimney Corner, and Broad Cove coal mines was next examined, together with the country underlaid by the Lower Carboniferous, gypsum, and limestone strata, the gneisses and felsites of Cape Mabou, and the traps and diorites of the Broad Cove Intervale (Strathlorne) which appear to be the same as those of south-west Margaree and Cheticamp, and to belong to the base of the Carboniferous system. The coal measures occupy small basins on the sea coast. In many places the seams of coal are in juxtaposition with large beds of gypsum, and all the measures hold crystals and veins of selenite. Fossiliferous black shales abound near Mabou and Broad Cove. A little coal has been extracted at Mabou. A great deal of money has been spent in developing the mines at Chimney Corner and Broad Cove.

The latter is by far the most important field, but the absence of suitable harbors retards the progress of coal mining on the northern shores of Cape Breton. An expensive wharf was built at Chimney Corner, and a breakwater at the mouth of Broad Cove River, but both are now out of repair. It is proposed to remove the bar at the mouth of Isaac Pond, and surveys have been made for this purpose. The water inside is deep, and a breakwater here would, it is thought, be less liable to be destroyed. The distance to Broad Cove mine is only a mile and a-half.

It has been necessary to make surveys of all the roads, brooks and lakes in the country, the only existing map being the admiralty chart of the coast on a scale of four miles and three-quarters to one inch. There are not even Crown land maps of the settlements in northern Cape Breton, and outside these is a *terra incognita*, but in which valuable veins of gold and silver have a reported existence.

This great unknown land may be said to be north of a line drawn from Margaree Harbor to the North River of St. Ann's, but within it, on the coast, are the thriving settlements of Cheticamp, Pleasant Bay, Bay St. Lawrence, Aspey Bay, Mills' Harbor, and Ingonish. Much of the interior is occupied by large barrens, over which roam herds of cariboo. On a small barren not far from Big Intervale Margaree, about 150 cariboo were counted one day towads the end of October. Moose, at one time also numerous, are now scarce. Along the shores of this northern region, and running into the bays and glens, is a narrow Carboniferous belt, through which the older gneissic and felsitic rocks of the interior come bluffly to the shore in capes and headlands.

The settlements are all on the Carboniferous belt. Inland there are Pre-Cambrian rocks, similiar to those described in the previous reports, as forming hills around Bras d'Or Lakes and elsewhere in Cape Breton. To these belong the Middle River gold bearing rocks, from which probably the gold was derived, mentioned by Mr. Campbell as being found in the Cheticamp and other neighboring rivers.

Galena occurs in many places in the Carboniferous limestone, and at South-West Margaree and Pleasant Bay it has been worked. Copper pyrites is found among the traps of Cheticamp, and in a diorite at Cape Rouge. Also in the rocks of St. Ann's Bay and the North River where a small vein has been worked which holds galena, zinc blende and copper ore. The copper mine at Coxheath has been sold to a United States Company, and now yields a large quantity of promising ore.

In October and November, some time was spent in a re-examination of the country around the head of Loch Lomond, where the Hon. E. T. Moseley, Esq., of Sidney, is now actively working some very important deposits of manganese ore. A large quantity has already been raised, and this mine promises to be of great value, some of the ore being valued at $100 per ton.

The northern part of Cape Breton Island is deserving a more careful exploration than it has as yet received. The difficulties of such an exploration have been much exaggerated. There are very few of the rivers and brooks that could not be ascended by wading during the low water of summer. In the lower part of their courses they cut deeply into the rocks, but the necessity of first surveying them to map the country, left but little time for a careful examination of the geology. It was found impossible to finish the survey last summer, owing partly to the wet season, and an early fall of snow, 5th October, which, although it disappeared from the lowlands, lay on the hills, and made the water of the large streams too cold to wade in. A few brooks remain to be traversed in Victoria county, between Ingonish and St. Ann's, and the Baddeck River has yet to be surveyed."

On the 5th November, Mr. W. Fletcher, B.A., assistant attached to the party was unfortunately drowned when crossing the North East Margaree River.

Last spring an arrangement was made with the Hon. S. H. Holmes, Attorney-General and Premier of Nova Scotia, by which the Provincial Government consented to share in equal proportion with the Geological Survey, the cost of a thorough topographical survey of the Nova Scotia gold fields. In accordance with this arrangement, the survey was commenced in June last, under the superintendence of Mr. William Bell Dawson.

The district covered by the season's work extends eastward from Halifax Harbor to Lake Porter. It comprises an area of about two hundred square miles, and includes the Lawrencetown, Montagu and Waverley gold fields with the intervening country. The survey is an instrumental one, made chiefly with theodolite and micrometer telescope, and embraces all the topographical details of importance, as well as the position of all "leads," shafts and workings. The information obtained is sufficient to enable large scale plans of these gold fields to be prepared, in addition to the general geological and topographical map to be published, on such scale as may be considered desirable. There is at present no map on which the position of leads can be marked or their probable course ascertained with any approximation to accuracy, and it is, therefore, thought that the survey, if carried out, will prove of much value to the gold mining interests of Nova Scotia, as it will afford a basis for mining operations not previously obtainable.

The cost of the survey to 31st December has been $1,500.

The liberal and enlightened action of the Nova Scotia Government in co-operating with the Dominion Geological Survey on the terms above stated, may be recommended for the favorable consideration of the other Provincial Governments who desire to expedite the geological survey of their respective territories, and thus more speedily acquire an accurate knowledge of the extent and value of their mineral resources, and the aid which accurate maps would afford in the development of them.

Palæontology and Natural History.

Up to the 1st of May most of the time of the Palæontologist and of Messrs. Foord and Weston has been spent in attending to the packing, not only of the extensive collections of fossils in the museum and store rooms, but also of office furniture and effects for removal to Ottawa. Before leaving Montreal the remarkable series of fossil fishes, collected by Mr. A. H. Foord, in 1880, from the Devonian rocks of Escuminac Bay, P.Q., was carefully studied, and a preliminary description of each of the species published in the *Canadian Naturalist and Geologist*. A more condensed description of the same specimens has also been published in the June number of the *American Journal of Science*, and has been reprinted verbatim in the August number of the *Annals and Magazine of Natural History*, London, (England). Fuller diagnoses of the species proposed in these papers, accompanied with illustrations, are in preparation for a forthcoming report. Since the removal to Ottawa most of the fossils intended for exhibition in the cases, have been selected, classified and re-arranged in the new museum. The nomenclature of each of the species exhibited so far, has been verified and revised. Those fossils which have been collected recently, and which require to be reported upon, have been unpacked and arranged in cabinets in the palæontologist's room. The fossils from the Cambro-Silurian deposits of the valley of the Red River, Manitoba, collected by Dr. R. Bell in 1880, have been critically examined and identified and a list of the species is published as an appendix to Dr. Bell's report. Report of Progress 1879-80, pp. 57-58 c.

During the past summer a new locality of fossil fishes has been discovered by Mr. R. W. Ells in Devonian limestone and breccia at Campbellton, N.B. These deposits have since been systematically explored by Mr. Foord. A provisional description of the fauna, as exemplified by the collection made from them by Mr. Foord, which consists of more than 200 specimens, has been published in the *Canadian Naturalist and Geologist* in advance of the publication, with illustrations, in the survey reports.

Mr. Foord has also made large collections of fossil fishes and plants from Escuminac Bay, P.Q.; of shells and corals from the Silurian rocks of the Nouvelle River, P.Q., and Cape Bon Ami, N.B.; of fish remains from the Mabou coal mines, Cape Breton, and of fish spines from the Gaspé sandstones of Gaspé Bay.

A small but interesting series of reptilian and fish remains from the tertiary deposits west of Manitoba has recently been received from Professor John Macoun; and some rare fossils from the Trenton and Utica formation of the immediate neighborhood of Ottawa, which were not previously represented in the collection, have been presented to the museum by Messrs. W. R. Billings, F. R. Latchford, H. M. Ami and J. W. H. Watts.

The number of specimens of fossils added to the collection during the past year is between 1,100 and 1,200, and of these about one-half have either been identified, or otherwise reported upon, and the rest have been subjected to a preliminary examination and partial study.

The Laboratory.

Consequent upon the removal of the Survey to Ottawa, and pending the fitting up of the new laboratory, the work in this branch was necessarily for a time suspended, and unfortunately after the fitting up had been completed, towards the end of August, the progress of the work has been very seriously retarded and interrupted, owing to the difficulty experienced in obtaining the requisite, steady, and sufficient supply of gas, and it is feared that this will continue unless the laboratory is supplied by a special pipe direct from the city gas works, involving a considerable expenditure.

A few analysis of technical importance have, however, been carried out, and several examinations of interesting minerals have been made. Much time has also been occupied in giving information, either personally or by letter, about minerals brought or sent for identification.

The Library.

Owing to the packing up and removal of the library, and the illness and retirement of the Librarian, no exact record of the number of publications distributed, or of volumes received, is available. Amongst these, however, may be mentioned an almost complete set of the Proceedings of the Royal Geographical Society; a large number of the publications, maps and reports of the Geological Survey of the United Kingdom; and 11 volumes, 4to, of the Philosophical Transactions of the Royal Society of London. Many other valuable publications have been received in exchange for the reports of the Suvey, the distribution of which has been not less than in former years.

In September, Mr. A. B. Perry, Graduate of Kingston Military College, was temporarily appointed for three months as Acting Librarian, and during that time he arranged, labelled and numbered nearly all the books in the library, and made very considerable progress in the preparation of the catalogue.

The removal to Ottawa has necessitated the purchase of the books which, though the property of the late Sir W. E. Logan, have always formed part of the Survey library. Most of these are current publications, the earlier volumes of which were subscribed for by Sir W. E. Logan, while of late years the subscriptions have been paid from the Survey funds, thus making one portion of the series the property of the Survey, and the other the property of the Logan estate. Under these circumstances, and considering the difficulty of replacing these volumes, it has been deemed advisable to purchase them from the administrator of the estate.

The total number of volumes thus purchased is 715, and 41 maps in portfolios.

The surveying, mathematical, and optical instruments in use by the Survey, but the property of the Logan estate, have also been purchased. The total amount to be paid for these properties being—books, $1,500; instruments, $3,000. The valuation placed on them is very considerably less than was paid for them by Sir W. E. Logan. And as they were purchased for, and have always been used in the public service, the compensation to the estate was deemed a fair and equitable adjustment of the matter.

Visitors.

Owing to the work still in progress, the museum has not yet been announced as open to the public. It has, however, been visited by 296 persons during the month of December, a larger number than at any previous similiar period of its history, and a gratifying assurance that, when arranged and formally opened, it will be a popular institution.

The foregoing summary of the operations of the Geological Corps was submitted for the information of the Government on the 31st January 1882. In the present volume detailed reports are given of some of the investigations named, also further information—Notes and Reports—relating to the work up to 31st December 1883, as summarized in the following report presented in January last for the information of the Government. It will thus be seen that this volume contains reports of portions of the work of the three seasons, 1880-81-82.

1882.

During the past year the explorations, surveys, and scientific investigations made by the staff of the Geological and Natural History Survey branch of the Department of the Interior have, as in former years, included portions of nearly all the Provinces and Territories of the Dominion, from British Columbia to Nova Scotia. Interesting and valuable additions have been made to our knowledge of the geography, geology, and natural history of the districts explored; and the general work of the survey in the field, having in view the construction of complete mineralogical and geological maps of the Dominion, has made satisfactory progress. The detail will be given in the usual Annual Report of the survey, which will be prepared when the collections and observations have been studied and arranged, and the measurements plotted, which, with the ordinary duties connected with the museum, will fully occupy the time and attention of the staff during the winter. In the meantime the investigations above alluded to may be briefly summarized as follows:—

British Columbia.

In British Columbia, Mr. Amos Bowman, who ably assisted Dr. G. M. Dawson in the western part of that province in 1876, has been engaged during the summer in working out details of the topography and geology of the southern interior east of the Fraser River. On the map of this region, published in connection with the report of progress for 1877-78, the main points of its geological structure were shewn for the first time, and the geography of the region laid down more completely than had before been possible. This map, however, left much to be desired, as this district, on account of its accessibility and comparative freedom from dense forest, is peculiarly suited to become a typical one, geologically, for the Province. It is, besides, that to be traversed by the Canadian Pacific Railway, and is known to contain coal and other economic minerals. The investigations of Mr. Bowman during the past season have added much to our knowledge of it; and the future prosecution of them will probably render desirable the preparation of a second edition of the maps at an early date. The expenditure on this exploration has been $1,800.00.

North-West Territories and Manitoba.

In the Report of last year it was stated that Mr. McConnell would remain at Calgary during the winter, to be in a position to resume as early as possible in the spring the surveys and explorations which were commenced in 1881, by Dr. G. M. Dawson, of the important coal fields of the North-West, situate in the Bow and Belly River districts, of which a preliminary report was prepared by Dr. Dawson and published in May, 1882.

During the past summer the examination of the country extending from the base of the Rocky Mountains eastward to the 111th meridian and from the international boundary northward to the 51st parallel, has been completed by Mr. McConnell.

After finishing the work on the plains, the remainder of the season, from the 1st August, was spent in the foot-hills and outer ranges of the mountains, where the line of junction of the newer coal-bearing rocks of the plains with the older rocks of the mountains was examined and defined. The principal topographical features of the foot-hills and outer ranges were sketched in as carefully as time permitted, the measurements being made either by odometer, pacing, or by rough triangulation. The disturbed formations adjacent to the mountains were also traced out and examined, and two barometric sections were made across the Porcupine Hills, north-west of Fort McLeod. Scabby Butte was also re-visited, and a large and interesting collection was made there of reptilian bones, probably of Dinosaurs, some of which are now exhibited in the museum. It is hoped that further research may lead to the discovery of enough of these bones to reconstruct the entire skeleton of one of those gigantic extinct reptiles, compared to which the mammoth would be a dwarf.

The most important coal seam in the region examined and described in the preliminary notes by Dr. G. M. Dawson, above referred to, occurs near the base of the Pierre shale formation. This seam has now been traced, varying in thickness from one and a half to five feet, from the international boundary to the Red Deer River—a distance of 175 miles. Several other seams were examined on the Red Deer River. The thickest, shewing six feet of coal, occurs not far above the summit of the Pierre shales, and is probably on the same horizon as the seam at the Blackfoot Crossing and at the Scabby Butte. A sketch survey was made of the Red Deer River, for about 100 miles, from the mouth of Rose-bud Creek down to Hunter's Hill; and, on the return eastward at the close of the season, all the formations cut by the South Saskatchewan River from the mouth of Bow River to Swift Current Creek were examined, the most important feature here being the occurrence of a thick coal seam exposed at intervals from Medicine Hat up the river for forty miles. This seam is supposed to be at a lower horizon than any of those observed further west, and may underlie them throughout the region examined. In any case, the evidence of the past season's work tends still further to confirm the opinion that the coal fields of the North-west may be regarded as practically inexhaustible. The measurements made by Mr. McConnell during the season were:—

	1,000 miles by odometer,
	275 miles by pacing,
	450 miles by river (estimated.)
Total	1,725 miles.

The season's operations extended from 1st May to 3rd November, the latter being the date of Mr. McConnell's return to Ottawa. Cost—$1,599.64. The equipment, consisting of one waggon, seven horses, three saddles, harness, tents, two carts, canvas canoe, buckboard, &c., were left in charge of Mr. James Scott, Fort McLeod, and will, for the most part, be available for another season's work.

Dr. Bell was requested to proceed to the Athabasca-Mackenzie region, and to there examine and survey that portion of the Athabasca River hitherto unsurveyed between the confluence of Lake La Biche River and the Clear Water River; and further to examine as much as possible of the great, wholly unexplored, region south of Athabasca Lake, and lying between the Athabasca River and the 108th degree of longitude.

The first part of the programme was successfully carried out, and some interesting details were obtained in relation to the lignite coal-bearing strata of the upper part, and the petroleum and salt deposits of the lower part, of the Athabasca River, all tending to confirm the opinion of previous explorers as to the great prospective importance of this region in connection with these valuable mineral deposits.

A track survey was made of Lake La Biche, and thence of the La Biche River and of the Athabasca, from the confluence of the latter to its mouth in Athabasca Lake, a distance of about 270 miles in a straight line.

Of the investigation indicated in the second part of the instructions, namely, that of the region south of Athabasca Lake, Dr. Bell states: "That, after consulting the officers of the H. B. Co. and others at Fort Chipewyan, I found that there was no route known across this region; and, even if a route had been found, it would have been impossible to explore it, owing to the impossibility of obtaining supplies and reliable Indians." Dr. Bell therefore returned on the old route, by Methy Portage, Ile à la Crosse, and Green Lakes, to Carleton. At Ile à la Crosse a copy of a sketch map was obtained from Mr. Walter Francklyn, which he had made of his route from the Churchill River to Cree Lake, situate in the region in question. Mr. Francklyn also gave Dr. Bell much information about the country, and Dr. Bell procured from some intelligent Indians of the region, and others, various sketch maps and notes in regard to its geography. This information will no doubt prove useful in connection with future explorations.

From Methy Portage a track survey was made of the route to Ile à la Crosse Lake, and thence of the Beaver River to Green Lake, which was reached on the 4th of October. That portion of the route above referred to, between the Athabasca and the confluence of the Clear Water has already been frequently traversed and its features described in more or less detail, the latest account of it being that of Professor Macoun, published first in the Report of the Geological Survey for 1875–76, and since then (1882) in the same author's "Manitoba and the Great North-West." These accounts do not materially differ from that of Dr. Bell, except as regards the probable origin of the petroleum or "tar" deposits. Dr. Bell has, however, ascertained the interesting fact that the petroleum-saturated sandstones are of Cretaceous age, and of such extent and character as to lead to the idea that the sandstone itself might be utilized for fuel, or the petroleum might be profitably extracted from it. The saturated beds range from 100 to 150 feet in thickness and extend for many miles along the river. Dr. Bell believes the source of the petroleum to be in the underlying Devonian limestones, and not in the black shales mentioned by professor Macoun; also, that the impregnation has taken plaace, as in eastern America, from below upward. Neither the eastern nor western limit of this tar-impregnated sand-rock of the Athabasca and Slave Rivers has yet been ascertained. On Peace River the only known indication of its occurrence is where the same Devonian limestones appear at the surface from beneath the Cretaceous rocks, as is recorded by Professor Macoun. (Geological Survey Report 1875-6, p. 88). Dr. Bell was assisted by Mr. Lawson. He left Ottawa on the third of July and returned on the eleventh of November, having travelled about 5,460 miles. Expenses $2,500, including salary of Assistant.

Mr. Cochrane was requested to make a survey and exploration of the country east of Lake Winnipeg from the 53rd parallel of latitude southward, including the Berens River and the upper waters of the Severn, returning, if practicable, by way of Trout Lake, Lake St. Joseph, and

District of Keewatin (East) of Lake Winnipeg.

Lonely Lake, the whole of this area never having been explored. Mr. Cochrane reports that he was unable to procure guides for the country on the east side of the Height of Land between the Berens and the Severn; and he did not therefore attempt the return route indicated in his instructions. A continuous track survey was, however, made of the Berens River from its mouth to the Height of Land, about 115 miles, as well as about 75 miles of one of the head waters of the Severn. The Pigeon River, which is connected with the Beren., was also surveyed for fifteen miles from its mouth. The Big Black River, about 65 miles north of the Pigeon, was then ascended and surveyed for about 82 miles, beyond which canoes could not be taken. At this point a portage was made, southward, into one of the tributaries of the Poplar River, which was descended and surveyed to its mouth in Lake Winnipeg. Mr. Cochrane then proceeded up the east shore of the Lake to Norway House, with the intention of surveying and exploring the Jackfish (or Pike) River.. This, however, was found to be impracticable, the water being too low to make the ascent. A sketch survey was then made of the lake shore from Norway House to the Grand Rapid Post at the mouth of the Saskatchewan. Leaving Grand Rapids on the 6th September the Saskatchewan was ascended to the outlet of Moose Lake, the shores of which were surveyed and examined. The field work commenced on the 1st July and terminated on the 15th October. Expenses, $985.46. No economic minerals of importance were observed, and the rocks on the eastern coast, and as far inland as the examination extended, consisted almost entirely of the ordinary varieties of grey Laurentian gneiss.

Ontario and Manitoba.

The Geological Survey work during the past season in Ontario consisted in examinations made, by the writer, of several of the principal mines on Lake Superior, and of the whole of the north shore of the lake from Kaministiquia River to Echo Lake, east of Sault Ste. Marie, including the whole of Thunder Bay, portions of Black Bay and Nipegon Bay and Straits, Michipicoten Island, Bachewanung Bay, and Goulais Bay. The entire distance—probably about 800 miles—was traversed in a small Mackinaw boat, and the shore line was pretty closely followed. Current River, Thunder Bay, was left on the 13th July, and Sault Ste. Marie reached on the 20th August. Remarkably fine weather was experienced, and but little detention from adverse winds. The average temperature for July between 6 and 8:30 a.m. was 60°. 95 and for August between the same hours 61°. 52. Many days it was so calm that sailing was impossible.

In the whole distance only seven mines and one stone quarry were found, at which work was being prosecuted. These were, from Thunder Bay, eastward:—

1. Pie Island.
2. Silver Islet
3. Free-stone Quarry, Isle Verte, Nipegon Bay.
4. Michipicoten Island.
5. Mamainse.
6. Do.
7. Echo Lake.
8. Garden River (east of Sault Ste. Marie).

The Silver Islet Mine is the only one which has yet yielded any profit on the working.

At Michipicoten Island, and at one of the Mamainse mines, very large sums of money are being expended; but the surface works, as has been so often the case in the past history of Lake Superior mining enterprise, are altogether too far ahead of the underground explorations, which in August last could not be said to have afforded more than a reasonable prospect of a profitable mine, more especially when considered in connection with the unsuccessful result of the previous somewhat extensive exploration of the same mining areas.

At No. 7, the Echo Lake mine, work has been suspended since the date of my visit in July.

The origin, geological structure, and age of the formations around the shores of Lake Superior are points upon which much discussion has arisen and various opinions have been expressed. To study these questions was one of the main objects of the present exploration, and also to ascertain whether any sound reasons existed for adopting the new names by which it has been proposed to designate the interesting groups of strata which there constitute the so-called upper and lower Copper-bearing Rocks. The result of the observations made will be given in the annual report, when the facts have been further considered. At present the impression formed is that the names referred to are not required, and that generally the views expressed by the earlier explorers are more nearly correct than those subsequently advanced, the latter being for the most part based apparently more on theoretical considerations than, like the former, on personal examination of the region. During the present exploration a number of rock specimens were collected, and about forty photographs of scenery and of interesting geological sections were taken.

In July, August, and September Mr. Weston made an examination of the formations from Sault Ste. Marie eastward along the northern shores of Lake Huron. The Huronian strata were carefully, but unsuccessfully, searched for fossils, a good suite of rock specimens was, however, secured, and a number of fossils was obtained from the Cambro-Silurian formations, chiefly of St. Joseph and La Cloche Islands, where we find the eastern limit of the Sault Ste. Marie or St. Peter sandstones. Expenses, $272.42.

Leaving Sault Ste. Marie again on the 27th August, the writer proceeded by steamer to Prince Arthur's Landing, with the intention of examining the country, thence to Winnipeg, along the line of the Canadian Pacific Railway.

This could not be carried out, as the trains, owing to a break on the line, were not running, and there was no certainty when traffic would be resumed. It was, therefore, decided to proceed, *via* Duluth, to Winnipeg, which was reached on the 2nd, and left on the 5th of September, for Portage La Prairie and Westbourne, where some days were spent in examining the country around the southern shores of Lake Manitoba. No rock exposures were found, the surface of the country being everywhere covered with a deep black soil, resting on a great, but varying, thickness of drift, which is well exposed in the banks of the White Mud River. Some worked flint chips and arrow heads were found at one point on the lake shore, a short distance east of the mouth of White Mud River. They were apparently washed up from the bed of the lake. On the 11th September I proceeded to Brandon, and thence, southward, across the plains to the Souris River. Several days were spent in the vicinity of Souris City and around the Brandon Hills. Thence the country was examined *via* the Tiger Hills, Rock Lake, and the Pembina River to Emerson, arriving there on the 3rd October and leaving again to return east on the 5th. Cost of season's explorations $1,179.34.

It seems very desirable that further explorations should be made in the Souris valley and the adjacent country. The Cretaceous rocks which crop out there are apparently nearly on the same horizon as those in which the lignite coals of the Bow and Belly Rivers occur. A careful search may therefore, very possibly, result in the discovery of workable lignite coal beds, either in the lower part of the Souris River valley, or between it and the valley of the Pembina.

It is unnecesary to dwell on the vast importance of such a discovery to all the inhabitants of this magnificent agricultural region; but from the general drift-covered and even character of the country, and from the strata being practically horizontal over such wide areas, there is little hope, even though they exist, of coal beds being discovered, except accidentally, without having recourse to boring. From the comparatively soft nature of the strata to be penetrated, this would not be a very costly operation; but, in any case, twenty or thirty thousand dollars judiciously applied would be money well spent in view of settling such an important question. It is proposed during the ensuing summer to thoroughly investigate the matter, so far, at least, as a careful examination of the surface and of all natural exposures will enable this to be effected. Attention has been called to the probable value for brick making of some of the smooth fine-grained Cretaceous shales which are cut by the Souris and Assiniboine Rivers, and the result of experiments made by Mr. Hoffmann on the samples submitted to him will be given in the annual report. They seem to show that we have, in these shales, an excellent material for the manufacture of the most refractory bricks, if not also for fine earthenware; and, if workable seams of lignite should be discovered associated with these shales, the manufactures referred to would be greatly facilitated.

Quebec and New Brunswick.

The explorations and surveys in New Brunswick were continued during the season by Mr. R. Ells and Mr. W. Broad, those of Mr. Ells having extended into the province of Quebec, around the north shore of the Bay of Chaleurs and the Gaspé Peninsula, from Cape Rosier to Métis. The examination included the valleys of the Restigouche and Metapedia, and of the Dartmouth and St. John Rivers of Gaspé. The St. Anne and the Magdalen Rivers were also ascended, and some observations were made in the Shickshock Mountains. This region is probably an important one, but the difficulties in the way of its exploration are very great. The rough and precipitous character of the numerous streams proceeding from it, and the dense forest which covers the whole of the intervening country, except the rugged summits which rise to elevations above the tree line, together with the entire absence of tracks or roads of any kind, are obstacles which have hitherto prevented the acquisition of any really accurate geographical or geological details concerning it; and, before these can be obtained, the requisite surveys and explorations will probably have to be undertaken during the winter.

It can, however, now be affirmed that this extensive mountain region has no connection with the Cambrian (Lower Silurian) formations of the *Quebec group*, but is a detached area of the Pre-Cambrian formations which constitute the chief mineral-bearing belt of the Eastern Townships, extending from the Vermont boundary north-eastward to a little beyond the latitude of Quebec. In the Shickshock Mountain area as yet only serpentine and chromic iron have been recognized, but as these everywhere accompany the deposits of crysotile or asbestus, and the ores of copper, lead, antimony, and iron, with some gold and silver, in the region to the south-west, it is not unreasonable to anticipate their discovery in this unexplored area of the Gaspé peninsula. It should therefore be more closely examined, and its physical and geological features more accurately determined. The measurements and observations made during the past season by Mr.

Ells in furtherance of this object were, from the causes already referred to, chiefly confined to the proximity of the coast, and to some of the more accessible of the river valleys. In the prosecution of this work between Little Pabos and Métis 300 miles of road were chained, 135 miles of road and 275 miles of shore line were paced, and interesting and instructive photographs of the scenery were secured. Collections were also made of typical rocks and of the fossils from the newer formations which surround and lie against the older nucleus of the mountains. The highest peaks of these attain to elevations ranging from 2,000 to 3,700 feet above the sea, and were graphically described, now nearly forty years ago, by Sir W. E. Logan. (P. 13, Report of Progress, Geological Survey, 1844).

Mr. Ells was assisted by Messrs. Low, Brumell, and Peers, and the cost of the season's exploration was $1,376.61, including the salaries of Messrs. Low and Brumel to the first of October, and of Mr. Peers to the 15th of September.

In western New Brunswick, counties of York and Carleton, Mr. W. Broad continued the surveys and explorations, in which he has now been engaged for four seasons, assisted during the past season by Mr. Robert Chalmers and by Mr. McInnes, B.A.

Mr. Chalmer's attention was devoted entirely to the superficial geology of the area, and a detailed report of this investigation will be prepared.

Mr. Broad and Mr. McInnes devoted their attention chiefly to the procuring the additional data required to complete the map, and in doing this surveys were made of the different branches of the Eel, Meduxnakeag, Nackawick, Keswick, and Mactagnac Rivers. The roads on both sides of the St. John River, between Woodstock and Victoria Corners, were surveyed with odometer, and the banks of the river between the points named were measured by pacing. Various small streams and wood roads were also traversed, and Mr. Broad states that the region in which he has been working, embracing about 4,000 square miles, is now surveyed with minuteness of detail not hitherto attained in any other part of New Brunswick.

The field work commenced about the 18th of June, and was continued to the 13th of November. The cost including salaries of Messrs. Chalmers and McInnes, the former to the 20th of September and the latter to the 31st December, was $1,071.79.

Nova Scotia.

In eastern Nova Scotia, the work was continued by Mr. Hugh Fletcher; but owing to the lateness of the season, very little was done in Cape Breton before the 7th of June. A detailed examination was then made of the manganese mines, extensively worked by the Hon. E. T. Mosely, in the lower Carboniferous rocks at Enoch, Loch Lomond, and also a further examination of the copper mines which are worked in the Pre-Cambrian rocks of the Coxheath hills, and which were described p. 123 F. of the Geological Report, 1879-80.

The Survey of the Baddeck and St. Ann's Rivers was then resumed, and finished about the end of August. On the lowland near the mouths of the rivers of this region, and along the "intervals" or alluvial flats which border them for many miles, Carboniferous strata occur, while the adjoining hills are composed of gneissic, granitic and felsitic rocks, making the structure of the country both physically and geologically similar to that of other portions of Cape Breton previously examined.

The remainder of the season was occupied in Guysboro and Antigonish counties, in continuing the work commenced in 1879-1880. In September heavy rains caused the suspension of the survey of brooks and lakes much earlier than usual; but nearly all the roads of Guysboro county, and many in Antigonish, were traversed by odometer or by pacing, and subsequently a preliminary inspection of most of the gold fields was made.

Near Guysboro there are deposits of specular iron ore like those described p. 122 F. Report of G. S. C. 1879-1880. The most important of these is worked by the Crane Iron Company, of Philadelphia. Three thousand tons of excellent ore have been taken out; but the distance from a good shipping place and bad roads renders its transport very costly. It sells in the United States for $7 and $8 per ton of 2,000 lbs., and is used as a lining for puddling furnaces.

The examination of this mine was greatly facilitated by the kindness of the manager, Mr. James Williams.

In November Mr. Fletcher spent some time at Albert, in New Brunswick, examining the curious copper deposits which occur there in so many places, in the form of grey copper ore replacing vegetable remains in the Carboniferous rocks, and also a yellow copper pyrites in rocks similar to those in which the Coxheath copper mine in Cape Breton is worked—probably Pre-Cambrian. One of those deposits in New Ireland seems to be well worth developing. Owing to litigation the work is now suspended.

Mr. Fletcher also visited and examined the coal seam on the Debert River, Londonderry county, but no definite information concerning it could be obtained. Many shallow pits have been sunk on the river flat, from which fragments of bright clean bituminous coal have been thrown out. The pits were all full of water, but there was no evidence to show that in any of them a solid seam of coal had been cut. Reports state the seam to be four feet thick, underlaid by a small seam of fire clay, and this by more coal. A seam of about the same thickness, opened years ago on the opposite side of the river, is stated to consist of black shale with only three bands of good coal, none of which exceeds four inches in thickness. This is probably the character of that found in the shallow pits above referred to. A brief examination was also made in December of some of the gold mines in Halifax county.

Mr. Fletcher was assisted by Messrs. John McMillan, Rodolphe Faribault, J. A. Robert, and M. H. McLeod. The field work continued from June to December; expenses, $1,315.00, including salaries of assitants, two to the 31st of August and two to the 15th of December.

The topographical survey of the Nova Scotia gold fields by Mr. W. Bell Dawson referred to in my last summary report as having been commenced in June, 1881, with the co-operation of the Provincial Legislature, was, it is to be regretted, not continued during the past summer, no funds having been provided for the purpose by the Local Government.

On the 12th June the plotting of the field observations was completed and plans were made of the Laurencetown, Montague and Waverly gold fields on a scale of 500 feet to one inch and also one sheet of the general map, embracing 18 by 12 miles, or 216 square miles, was prepared on a scale of two inches to the mile.

The surveys have extended beyond the limits of this sheet, and these have been plotted separately, to be included in the next sheet, so soon as the continuation of the field work will enable this to be prepared. The cost of the survey, as found by dividing the total expense by the area covered, is $16.75 per square mile.

Paleontology and Natural History.

With a view to exhibiting the whole of the species in the possession of the Survey, from each formation, a reclassification of the fossils in the museum has been commenced. This reclassification, which is being ably carried out by Mr. Tyrrell, has necessitated the opening of about one hundred boxes of specimens, from which many of the species have been selected, identified, labelled, and incorporated into their proper place in the collection. The rearrangement of the fossils of the St. John's, Potsdam, Calciferous, and Chazy formations has been completed, and much progress has been made in the reclassification of the Silurian and the rest of the Cambro-Silurian species. The nomenclature of all the Cambrian and Cambro-Silurian fossils, with the exception of those of the Hudson River formation, has been revised, and new labels for each species have been printed.

The graptolites and other fossils collected by Mr. T. C. Weston in 1877, and by Mr. R. W. Ells in 1882, from the coast between Matanne and Little Fox River, in the province of Quebec, have been studied by Mr. H. M. Ami, and identified so far as their state of preservation would admit.

A critical and microscopical revision of the Canadian *Monticuliporidæ* has been commenced by Mr. Foord, and the results of his investigations, which have been based on 284 thin sections skilfully prepared by Mr. T. C. Weston, will be published at an early date.

The Survey is again indebted to Principal Dawson for the preparation of the second part of his Report on the Devonian (Erian) and Silurian fossil plants of Canada. This Report, consisting of forty-nine pages of letterpress and four plates, R. 8vo., has been printed and distributed during the summer.

Two papers, one "On the Fossils of the Lower Cretaceous Rocks of British Columbia," and the other "On some supposed Annelid Tracks from the Gaspé Sandstones," have been prepared and were read by Mr. Whiteaves at the first meeting of the Royal Society of Canada in Ottawa. Papers were also prepared and read at the same meeting by Professor Macoun "On the Distribution of Northern, Southern, and Saline Plants in Canada," and by Dr. Bell, on the "Birds of Hudson's Bay."

At the meeting of the American Association for the Advancement of Science, held in Montreal last August, some of the most interesting fossils collected by officers of the Survey during the past three years were exhibited in the Geological Section. Before the same section, also, two papers were read, one "On the Recent Discoveries of Fossil Fishes in the Devonian Rocks of Canada," and another "On the Occurrence of *Siphonotreta-Scotica* (Davidson) in the Utica Formation, near Ottawa, Ontario." In the Biological Section a paper was read "On a Recent Species of *Heteropora* from the Strait of Juan de Fuca." Two of these papers have since been printed *verbatim* in the October number of the *American Journal of Science.* Assistance has been given to Professor W. Dwight, of Vassar College, Poughkeepsie, New York, in the preparation of a paper read at the same meeting, "On the Geology and Paleontology of the Wappinger Limestones of Duchess County, New York," by the comparison of suites of fossils forwarded from that locality with Canadian types in the museum of the Survey.

A collection of 200 specimens, from the Hamilton formation in the vicinity of Widder, Ontario, comprising many species not formerly represented in the museum, and some apparently new to science, has been presented to the survey by the Rev. Hector Currie. A catalogue of the species contained in this collection has been made and forwarded to Mr. Currie, together with a series of duplicates from other formations.

To the kindness of the Rev. J. M. Goodwillie, of Calamachie, Ontario, the Survey is also indebted for a series of rare fossils from the Niagara and Hamilton formations; and lists of the species presented have been made and mailed to the donor.

120 specimens of fossils from the Medina, Clinton, and Niagara formations have been presented by Colonel Grant, of Hamilton, Ontario. A slab about seven feet long, the finest specimen known of foot prints of *Sauropus unguifer* (Dawson) from Nova Scotia, was presented by Sandford Fleming, Esq., C.M.G. A cast of this unique specimen has been made and presented to the Redpath Museum, Montreal, and a smaller specimen, from the survey collection, of foot-prints of the same species was presented by request of the donor, to the University of Kingston.

Mr. H. W. Ami has presented 125 specimens from the Utica formation near Ottawa; and Mr. W. H. Billings has presented seven named species from the Trenton limestone, near Ottawa, not previously in the collection.

The principal collections of fossils made by officers of the survey during the past year are as follow:—

By T. C. Weston.—About 100 specimens of Carboniferous fossils from the S. Joggins, Nova Scotia, including two large stumps of *Sigillaria Brownii*, leaves of *Cordaites* slabs of *Anthracomya*, *Stigmarian* roots, *Calamites*, *Lepidodendron*, *Dadoxylon* *Lepidophloios*, *Spirorbis*, and scales and teeth of fishes. About 100 specimens of Black River and Trenton fossils from Gravel Point, St. Joseph's Island, Lake Huron.

By A. H. Foord.—Twenty-three specimens of fossil fishes from the Devonian rocks of Scaumenac Bay, P.Q., and 130 from Campbellton, N.B.

By R. G. McConnell.—About 100 specimens of molluscous and vertebrate fossils from Milk River Ridge, Highwood River, South Saskatchewan, and other localities in the Bow and Belly River districts, North-West Territory—all of Cretaceous or Tertiary age.

By A. H. Foord and H. M. Ami.—About 100 specimens of fossils from the Trenton limestone, near Ottawa.

By R. W. Ells.—Twelve specimens of graptolites from Matanne, three from the Marsouin River, and twenty-five from Gagnon's Beach, P.Q., 615 fine and rare fossils mostly from the Guelph Silurian limestones, have been acquired by purchase from Mr. Joseph Townsend, of Durham, Ontario.

Collections of fossils containing about 182 species have been sent to Queen's College and to the Royal Military College, at Kingston, and twelve more are in course of preparation for distribution to other local educational institutions. A number of casts of tracks from the Potsdam formation has been presented to the museums of the Universities of Toronto, Kingston, McGill and Laval.

Early in the year, Professor John Macoun, of Belleville, was appointed Botanist and Natural History Collector to the Survey, and during the summer he was occupied in investigating the botanical features of the western peninsula of Ontario, from the head of Lake Erie to the Niagara River. Later, towards the end of July, he proceeded to Gaspé, and there investigated the coast and alpine flora of that interesting peninsula. The Shickshock Mountains were ascended, and the coast was carefully examined from Cape Rosier to Ste. Anne des Monts (about 200 miles), as were also portions of the shores of Gaspé Bay and of the Bay of Chaleurs. Specimens of the rarer species and of others not represented in the herbarium were collected; material, moreover, was obtained for a full report on the botany of the regions explored. Professor Macoun has been engaged during the autumn in classifying and arranging the herbarium, and has commenced the preparation of a complete catalogue of Canadian plants, the first part of which will be ready for publication during the ensuing year.

In November, Professor Macoun was instructed, at the request of the Minister of Marine and Fisheries, to make a collection for the forthcoming Fishery Exhibition of objects of marine natural history, especially sea weeds. After consultation, it was decided that the shores of Prince Edward Island, and of the south-western part of Nova Scotia, would afford the best facilities for the work. Accordingly Prince Edward Island was first visited, and then Halifax and Yarmouth. Professor Macoun left Ottawa on the 16th November, and returned on the 14th December. He succeeded in making a fair collection; but it is to be regretted that the work was not undertaken earlier, and at a season of the year when it would have been possible to attain results more complete and more commensurate with the importance of the object in view. Since his return, considerable time has been spent in arranging and preparing the collection for exhibtion.

Of the collections in recent natural history, alluded to in my report last year, two have since been purchased for the museum. The most important of these is the very fine collection of shells, the property of Mr. Whiteaves containing nearly 6,000 species, and upwards of 14,000 specimens, from all parts of the world; together with a fine collection of named Jurassic fossils, in which 598 species are represented by about 1,800 specimens—in all, upwards of 15,000 specimens, for the very moderate sum of $2,000. About 3,000 species are now temporarily arranged in trays, in the museum, preparatory to their being permanently mounted and labelled. The other collection referred to is one of Canadian birds and mammals, the property of Dr. Bell. It represents thirty species of birds, and thirteen species of mammals, and consists of fifty-six specimens. This collection is mounted and exhibited, and was purchased for $719. In connection with it, and with the considerable collection of bird's skins, already made by Professor Macoun, and now in the museum in drawers, and in view of further additions to the recent natural history collection, the services of an efficient taxidermist are greatly needed. I would also, in this connection, again call attention to the necessity of taking some steps to provide additional accommodation, either in the manner suggested in my report last year, or in any other which may be deemed more desirable.

Chemical and Mineralogical.

The work in this branch of the Survey during the past year has, apart from the analysis of one or two minerals possessing chiefly a scientific interest, consisted almost exclusively in the examination and analysis or assay of minerals of economic importance, including gold, silver, copper, lead, iron, manganese, and plumbago; also, the testing of certain clays in regard to their adaptability to brick making, and the partial quantitative analysis of some lake and river waters.

A series of analyses of the North-West lignite coals has been commenced, and is now in progress. This, when completed, will probably show, in a very interesting and conclusive manner, the intimate connection which apparently exists between the economic value of the seams and their proximity to areas which have been, either locally or generally, affected by movements of upheaval or depression producing heat and pressure.

Rather more than two hundred mineral specimens have been received for identification, or for an opinion of their economic value. In all cases the information asked for has been given, either personally or by letter.

The defective supply of gas in the laboratory mentioned in my last report has been remedied by the means then suggested, and no further difficulty in that respect has been experienced; and, with the exception of the apparatus for procuring distilled water, the fittings in the laboratory and in the assay room are now satisfactorily completed.

In 1881, Mr. Adams obtained, on my recommendation, six months leave, to visit Europe for the purpose of studying lithology, and acquainting himself with the latest and best methods in use for the microscopic examination of rocks. Since his return, in September, 1881, his time has been about equally divided between chemical work and micro-lithology; and he has examined and determined by this method a large number of the interesting crystalline rocks of the "Quebec Group," the character and geological relations of which could not be otherwise ascertained with certainty.

Mr. Hoffmann's time and attention has also been devoted to superintending the arranging, classifying and labelling of the mineralogical and stratigraphical collections, work which has been ably and industriously carried out by Messrs. Willimott and Broadbent; to complete this undertaking, however, a considerable amount of labour is still required.

Twenty names have been entered as having presented specimens to the mineralogical collections during the year. All such specimens, when in the museum, are labelled with the name of the donor.

Four papers were prepared by officers of the Survey and read at the meeting of the Royal Society of Canada in the Geological Section—by Dr. Bell, on "The Present Condition of the Mining Industry in Canada." And on "The Discovery of Zinc Blende on the North side of Lake Superior;" by Dr. G. M. Dawson, "Descriptive Notes of a general section from the Laurentian Axis to the Rocky Mountains;" and by the writer, on the "Quebec Group."

Twenty-one named collections of minerals and rocks have been made, labelled, catalogued, and distributed to educational institutions. These comprised in all 2,283 specimens. About 100 boxes of specimens have been opened, sorted, and classified, the useless specimens being rejected and the remainder, not wanted for the museum, repacked in such a manner as to be easily available for reference or exchange or for making up collections for presentation. This work was performed by Mr. C. W. Willimott, assisted by Mr. Brumell. In August and September, Mr. Willimott visited and examined several mining districts for the purpose of procuring specimens wanted for the museum collection, and also material for collections for distribution to educational institutions. At the same time statistics of all the mines visited were obtained, the details of which will be given in the annual report now in course of publication.

Library.

During the year ending 31st December last, 3,268 copies of the Survey publications have been distributed, a larger number than during any previous year. Of these 2,372 were distributed in Canada, 1,902 being in the English language and 470 in French. The remainder (869) were sent to scientific and literary societies in America, Europe, India, Japan, and Australia. In return for these, 435 publications, including books, transactions, memoirs, periodicals, pamphlets, and maps have been received. Many of these publications and a large number of other valuable books in the library are still unbound, and consequently it is only with difficulty, and at the risk of injury, that they are available for reference by the public or by members of the staff.

Since the 20th May last, the Government contractor has only accomplished the binding of 138 volumes, at which rate of progress it will require four years to finish binding the books now in the library.

Thirty-three scientific magazines and periodicals have been subscribed for, a list of which is given in the Annual Report.

Eighty volumes have been added to the library by purchase.

There are now in the library about 4,500 volumes. The catalogue is being proceeded with, and will, it is hoped, be ready for printing some time during the ensuing year.

Visitors.

9,549 names have been entered in the register of visitors to the museum during the year, the largest number in any previous twelve months of its existence having been 1,652. This large increase of visitors must be regarded as exceedingly satisfactory for the first year of the establishment of the museum at the Capital; and I venture to express the hope that the future liberality of Parliament will enable the popularity and usefulness of the institution for practical, scientific, and educational purposes to be yet very largely increased.

Staff Appropriation and Expenditure.

The strength of the staff at present employed is thirty-eight of all classes, viz: professional, twenty-six; ordinary, twelve.

The appropriation for the current fiscal year ending 30th June next, was $60,000, against which the whole expenditure for the Geological and Natural History Survey, and for the maintenance of the museum, is charged, including the salaries and wages of all employés, which this year will amount to about $33,000.00.

The following changes have occurred during the year:—Dr. Thorburn was appointed Librarian on the 12th of April, 1882. Mr. A. Webster resigned on the 1st of October, after six months leave; and Mr. Wallace Broad was promoted to the vacancy. Messrs. Low and McMillan were appointed Assistant Field Geologists from the 1st of July, 1882; and Mr. Broadbent was appointed Museum Assistant (Mineralogical section) from the same date. Mr. Grignard was transferred, on the 5th of July, to the Dominion Lands branch. Dr. G. M. Dawson was absent in Europe, on leave without pay, from the 1st May to the 31st of December. While there he studied the process in use for the manufacture and utilization of lignite as fuel, a subject of considerable importance in connection with the development of the vast deposits of this material in the Canadian North-West. The result of Dr. Dawson's observations will be given in a future report.

Approximately stated, the expenditure during the six months, ending 31st December, 1882, has been, under the divisions named as follows:—

Salaries and wages	$16,474 91
Exploration and survey	13,480 42
Printing and lithography	633 46
Purchase of specimens	2,170 00
Purchase of books and instruments	332 62
Chemical and laboratory apparatus	101 84

Stationery	242 25
Fuel	598 95
Incidental expenses	596 24
	$34,630 69

The correspondence of the branch shows 1,445 letters sent and 1,938 received.

OTTAWA, January 1883.

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Reports. 1869-81.

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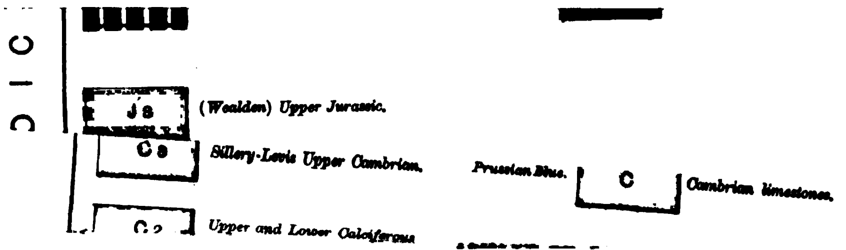
(Wealden) Upper Jurassic.
Sillery-Levis Upper Cambrian.
Upper and Lower Calciferous
Prussian Blue.
Cambrian limestones.
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DIRECTOR.

1881.

Geo E Desbarats & Co Montreal

GEOLOGICAL NOMENCLATURE

AND THE

COLORING AND NOTATION OF GEOLOGICAL MAPS

BY

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DIRECTOR OF THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

The scheme, the details of which are now given, for securing uniformity in Geological Nomenclature and in the coloring and notation of Geological maps and sections, was prepared for the consideration of the Geological Congress held in Bologna, in September, 1881. It has never been published, but as it has now been adopted for the maps and in the reports of the Canadian Geological Survey, I have considered it desirable that the explanation of it should find a place in the survey report for this year.

Though specially designed to meet the requirements of the Canadian Survey, embracing one half of the continent of North America and formations of every *Age* from the *Archean* to the "*Acrozoic*" * or *Human Period*, it is, I believe, applicable to all countries, and requires very little explanation. New or unknown terms have been studiously avoided, and the chief aim has been to give a definite and constant signification to terms already in general use, but hitherto with an ever varying meaning.

Absolute uniformity of procedure in the matters under consideration, however desirable in the interest of geological knowledge, will probably never be attained, but there seems no reason why in countries so closely connected as those of the United States and British North America, such perplexing differences as are now of constant occurrence, should continue. In the mean time, those who are actively engaged in carrying on extended State Surveys, cannot await the deliberations and final conclusions of a general Geological Congress, but are compelled at once to adopt some plan suited to the requirements of their own work, and having, after due consideration, done so, to change it is exceedingly inconvenient, and except for some very weighty reason undesirable.

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* This name denoting the summit or culminating point, was suggested by my colleague, Mr. J. F. Whiteaves. It is better than "*Anthropozoic*" suggested by myself or "Human Period" or "Age of Man," and I propose to adopt it, as it gives euphonious correspondence to the terminology used for the "Ages."—A. R. C. S.

1. STRATIGRAPHICAL NOMENCLATURE.

The terms I would propose to use, and their relative importance, chronologically and geologically, are as follows:—

1. Age.
2. System or Terrane (I prefer the former.)
3. Group.
4. Formation.
5. Series.
6. Bed or Stratum.

1 and 2 are of universal application, and can be uniformly colored and noted on maps, &c.; 3, 4, 5 and 6 are all more or less local, and would generally require local names and special colors to define them, and this should be done by lines, dots or other devices in the color or shades of the color adopted for the system to which the subdivision belongs.

In the above scheme,

An *Age* comprehends one or more *Systems.*
A *System* one or more *Groups.*
A *Group* two or more *Formations.*
A *Formation* one or more *Series.*
A *Series* a collection of *Beds* or *Strata.*

The terms Primary, Secondary, Tertiary, &c., are objectionable, the first as making no distinction between the Palæozoic and the very distinctly older systems, and the last because required for the system succeeding the Cretaceous. So, also, is the use of all the terms, *Age*, *Epoch*, *Era*, *Period*, *Time.* Those are all to some extent synonymous, and have no recognized or definite relation to each other as measures of time, like year, week, day; either of them might be adopted to denote the primary and largest or most comprehensive division of geological time. But whichever is adopted for this purpose, the others should be dropped. Considering the etymology and usual application of these terms, I consider *Age*, corresponding with the Greek *Eon*, in every respect the most suitable, notwithstanding its double signification, as the *age in which we live* and *his age is five years*, which, however, in practice, can never cause any confusion or inconvenience. Thus the *Ages* would be :—

1. Archean.
2. Palæozoic.
3. Mesozoic.
4. Cenozoic.
5. Anthropozoic or " Acrozoic " (summit or culminating point,) denoted by the Roman numerals I. to V.

The Systems:—

1. Laurentian.
2. Huronian.
3. Cambrian.
4. Cambro-Silurian.
5. Silurian.
6. Devonian.
7. Carboniferous.
8. Triassic.
9. Jurassic.
10. Cretaceous.
11. Tertiary.
12. Quarternary or Post-Tertiary. (Denoted by the letters A to M.)

The term Cambro-Silurian will probably be objected to. It is, however, advocated as being in Canadian stratigraphy convenient; as to some extent reconciling the conflicting claims of the eminent authors of the names, and further as indicating the stratigraphical and zoological continuity in the systems indicated.

We thus have five *Ages*, twelve *Systems*, and an indefinite and locally varying number of *Groups*, *Formations* and *Series*.

2. Coloring and Notation.

These, as proposed, are shown on the accompanying Chart or Index, and also in the published maps of a portion of the Canadian province of New Brunswick. In many respects, the colors selected appear to accord with those recommended by others, as expressed in the Reports of the several Commissions.

For large scale maps, where minor and purely local subdivisions of Groups and Formations or Series have to be represented, uniformity is impossible, and even in general or small scale maps tints will seldom correspond, and colors fade. I therefore consider the system of lines, dots or other marks in the color, and notation even more important in facilitating the reading and study of geological maps, &c., than the actual color.

I have supposed every system to be divisible into lower, middle and upper parts, these to be respectively indicated by vertical, inclined (left to right downwards) and horizontal lines, and further by figures 1 2 3 appended to the letter denoting the system. Any number of minor and local divisions can be indicated by the addition of a small letter (*a*) being always used for the lowest number, and so on in ascending order alphabetically. (See Chart.)

Crystalline stratified rocks of all *Ages* newer than the *Archean* would be defined by diagonal bars of the color used for the *System*, with (*m*) (Metamorphic) added.

Blue tints to be reserved for limestone strata and formations.

Deep Red tints (Carmine and Vermilion) to be used exclusively for *e*ruptive and *ir*ruptive rocks—the kinds being distinguished by white letters as shown on the Chart, and by bars, dots or other devices in the color.

If the age is known, the *System* letter can be added, thus—Fel. F. = Devonian Felsite.

All other geological references on maps, &c. (notes, letters and other conventional signs), should be printed in Red, and this can be usefully carried out on uncolored maps published to illustrate exploratory surveys.

For practical application see map of a part of the Canadian North-west Territory, published with Report for 1879–80.

All labels on specimens in museums should be colored to correspond with the color adopted for the System or Formation to which the specimen belongs, and the letter and number indicating the System and Subdivision should also appear on the label. If inconvenient to use the color, the letter and number alone would suffice.

I would likewise suggest that authors describing local formations under local names should after the name insert, in brackets, the letter indicating the *System*, and, if possible, the Subdivision to which the Formation, Group or Series belongs or is most nearly allied. Thus, in writing of the *Nipigon Formation*, I should add (C 1), and every one would know that a lower part of the Cambrian System was being described. So, in writing *Chazy*, I should append (D 1), indicating the lowest division in Canada of the lower part of the fourth or Cambro-Silurian System. The main features in the scheme may be recapitulated as follows :—

1. Definite colors for *Systems;* and for all subdivisions of systems, modifications of the same color by tints, lines or other devices.

2. *Age* colors to be the system colors combined in bars: thus, *Mesozoic Age* would be represented by any two or all (as required) of the colors used for the Triassic, Jurassic and Cretaceous Systems, with letters H. J. K. added, or the Roman numeral III. Or a single color might be used for each.

3. Vermilion and Carmine and other similar bright red tints to be used for igneous or supposed igneous, eruptive or irruptive rocks.

4. Blue to be used for limestone bands,—the System to which they belong being indicated by letter and tint.

5. All geological notes and references, letters, figures, etc., to be printed in red, except such as come on red-colored (igneous) areas; these to be in white. In the sample maps referred to, the printing of all the geological notes and references in red is not fully carried out, owing to a misunderstanding on the part of the printer.

6. Letters and numbers to be always used from 1 and A respectively in the ascending order of the Formation, Series or Beds.

7. No geological maps should be printed in less than two colors, *i.e.* black for the topography, and red or some other color in line, and various devices to represent the different Systems or Formations, with the same notation as used for fully coloured maps. On both colored and uncolored geological maps, the notation can often usefully be made to indicate what is not always apparent, viz., the formations which underlie that occupying the surface; thus, K. S. on E. 2 on B. would indicate Cretaceous (lower) on Silurian (middle division) on Huronian, or omitting names, 10th System lower division, on 3rd middle division, on 2nd.

8. In geological literature, the letter and number denoting the place in the geological sequence, of the formation named, should be added in brackets, as (C. 2^a) indicating the base of the middle divison of the 3rd system. By this means, local names entirely unknown to many readers would at once be intelligible to all.

9. Labels on specimens in museums should be colored and lettered to correspond with those of the System to which the specimens belong.

Ottawa, 29th August, 1881.

NOTES

ON THE

GEOLOGY OF THE SOUTH-EASTERN PORTION

OF THE

PROVINCE OF QUEBEC.

BY

ALFRED R. C. SELWYN, LL.D., F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.

Region described.

The region to which the following Notes refer extends from the boundary between Canada and the State of Vermont at Lake Memphremagog, north-eastward to the townships of Montmagny and L'Islet. It is limited to the south-east by the boundary between Canada and the state of Maine, and embraces a belt of country about 145 miles in length by thirty in width, or about 4,500 square miles.

Silurian and Devonian strata.

The greater portion of it is occupied by strata which belong to members of the Silurian (Upper Silurian) System. These consist of clay-slates, sandstones and limestones. The latter are exposed chiefly in the south-western half of the area, on the shores of Lake Memphremagog and in the vicinity of Dudswell, where some of the limestones afford excellent marble, specimens of which can be seen in the Geological Museum. The area has been already described in considerable detail by Sir W. E. Logan, in the XVIth chapter of the Geology of Canada, 1863. The rocks occupying it were then regarded as a part of the "Gaspé Series;" the limestones as being probably of Devonian age and the slates and sandstones beneath them as Silurian. The evidence on this point, owing to the badly preserved condition of the fossils, is still insufficient, but there seems in some localities to be such a mingling of Devonian and Silurian forms as to suggest the applicability of the name Devono-Silurian, proposed by Professor Edward Hull, or as I should prefer it, Siluro-Devonian, as being more euphonious and as indicating the upward direction of the passage. They rest everywhere along the north-western margin unconformably on and against the strata which form the great central axis of Pre-Cambrian age in the province of Quebec, and which were described by Logan as the "Altered Quebec Group." A ridge of these ancient sub-crystalline strata divides the Silurian area in the south-western portion, from the township of Ham to the shores of Lake Memphremagog and the Vermont boundary, and though rarely exceeding five miles in width, these older rocks form a prominent range of hills, some of which rise to 1,500 feet above the sea. This range known as the Stoke Mountains, has been described in the Geology of Canada, pp. 252 and 435, in such a manner as to leave little, if anything, further to be said respecting its physical or lithological characters.

Stoke Mountains.

The Geological relations of this belt correspond with those of the great central axis to the north-east, described in the Geological Survey Report for 1877-78, and again in more detail in a paper read by the writer at the first meeting of the Royal Society of Canada in May, 1882. The upper portion of this series was designated "the volcanic belt," from the association with it, especially on the south-east side of the main axis, of a grest variety of what were considered to be altered eruptive and irruptive rocks, but whether the strata forming this igneous belt are more nearly allied to the lower Cambrian than to the upper Huronian is not, fossils being absent, easily determined. In any case they are most certainly unconformably covered and overlapped to the north-west by fossiliferous beds of the Levis formation of the Quebec group, and to the south-east in the same manner, throughout their entire length, by the limestones, slates, and sandstones of the Siluro-Devonian trough above described; while between them and the more shistose rocks of the central axis by which they are underlaid, no unconformity has been detected; for these reasons, they are provisionally classed with the lower series, or as Pre-Cambrian probably upper Huronian.

Huronian or Lower Cambrian.

Microscopic examination of specimens.

Specimens of some of the most characteristic rocks of this belt have been submitted to a careful microscopical study by Mr. Frank Adams, Assistant Chemist and Lithologist to the Survey, and he has supplied me with the appended interesting notes respecting them. These seem to afford very decided support to the stratigraphical evidence and to conclusively prove that the rocks in question are largely of igneous origin and not ordinary altered paleozoic sediments. The evidence of a mixed volcanic and sedimentary origin is necessarily rather geological and physical than mineralogical, because of the excessive disturbance, denudation and alteration which has more or less affected the whole series. These causes have often almost obliterated original lithological and mineralogical characters, and therefore, notwithstanding that certain rocks are really of volcanic origin. That they are so is not easily proved either by chemical or microscopic examination.

Examination by Mr. Webster.

The Siluro-Devonian area now under consideration was traversed and examined during the seasons of 1880 and 1881, by Mr. Webster late of the Geological corps, chiefly with a view of investigating its auriferous character, and determining the limits of the several formations, as stated in my summary report. In reference to the gold, Mr. Webster says:—"The drift appears to have come from the north-east and is found overlying a bluish-grey boulder clay, in which no gold has been observed. The gold drifts contain fragments of local rocks and foreign boulders of Laurentian and newer formations."

Quartz veins.

"Few true veins of quartz occur in the Silurian rocks, but there are great masses of milk-white quartz, sometimes of considerable extent, forming lenticular patches in both the slates and sandstones."

Gold.

"Visible gold has been stated to occur in quartz at several places in the Chaudière valley and in the neighbourhood of Sherbrooke, but upon examination, this supposed gold has in every case proved to be either iron pyrites or mica—up to the present time I have never seen gold in any of the quartz veins or masses which occur in this region. The altitude of the gold-bearing drift appears nowhere to exceed 2000 feet above the sea. Below this height "colors of gold" may be said to occur anywhere to the south-east of the great Quebec Anticlinal, and most abundantly on the upper waters of the Chaudière and the St. Francis Rivers. It has also been found on the Maine watershed."

"The following is a list of localities where "*colors*" have been found, apart from places where regular mining operations are being carried on:

List of auriferous localities.

1. In drift lying on Pre-Cambrian rocks:

Lake Massawippi, Black Point, Hatley		R. V.	Lot 21.
Jack Brook	Ascot	R. VIII.	Lot 10.
Small brook between Sherbrooke and Lennoxville.			
Mouth of brook on line between Ascot and Stoke.			
Westbury	Stoke	R. VII.	Lot 28.
South Halifax		R. VII.	Lot 3.
Ireland		R. III.	Lot 4.
Do		R. V.	Lot 10.

In many places on the Bras du Sud Ouest River, Vaudreuil, Beauce.
On the Rivière des Plantes.
On the Colway and on a small stream to the north of it.
On the Rivière des Fermes.
On Mountain River.................................Coleraine.
Also in the townships of Ditchfield, Clinton, Woburn and Chesham on the borders of Maine.

2. In drift lying on Silurian rocks:

Key Brook	Brompton R. V. VI. Lot 28.
Magog River	Sherbrooke R. IX. XIII Lots 17-22.
Dudswell	R. VI. Lot
Do	R. III. Lots 14, 15.
"	R. II. Lot 38.
"	R. I. Lot 34.
Ditton	R. IX. Lots 17, 22, 23, 24.
"	R. IX. Lot 2.
"	R. XI. Lot 2.
In several places on Little Ditton River.	
Ditton	R. VIII. Lot 60.
"	R. VII. Lot 56.
"	R. IV. Lot 52.
At the mouth of the Mountain Brook, Hampden R. II. III.	

Along the Chaudière River and its tributaries from Lake Megantic to St. Joseph, fine gold can be found in almost every pan of earth washed from the bed rock."

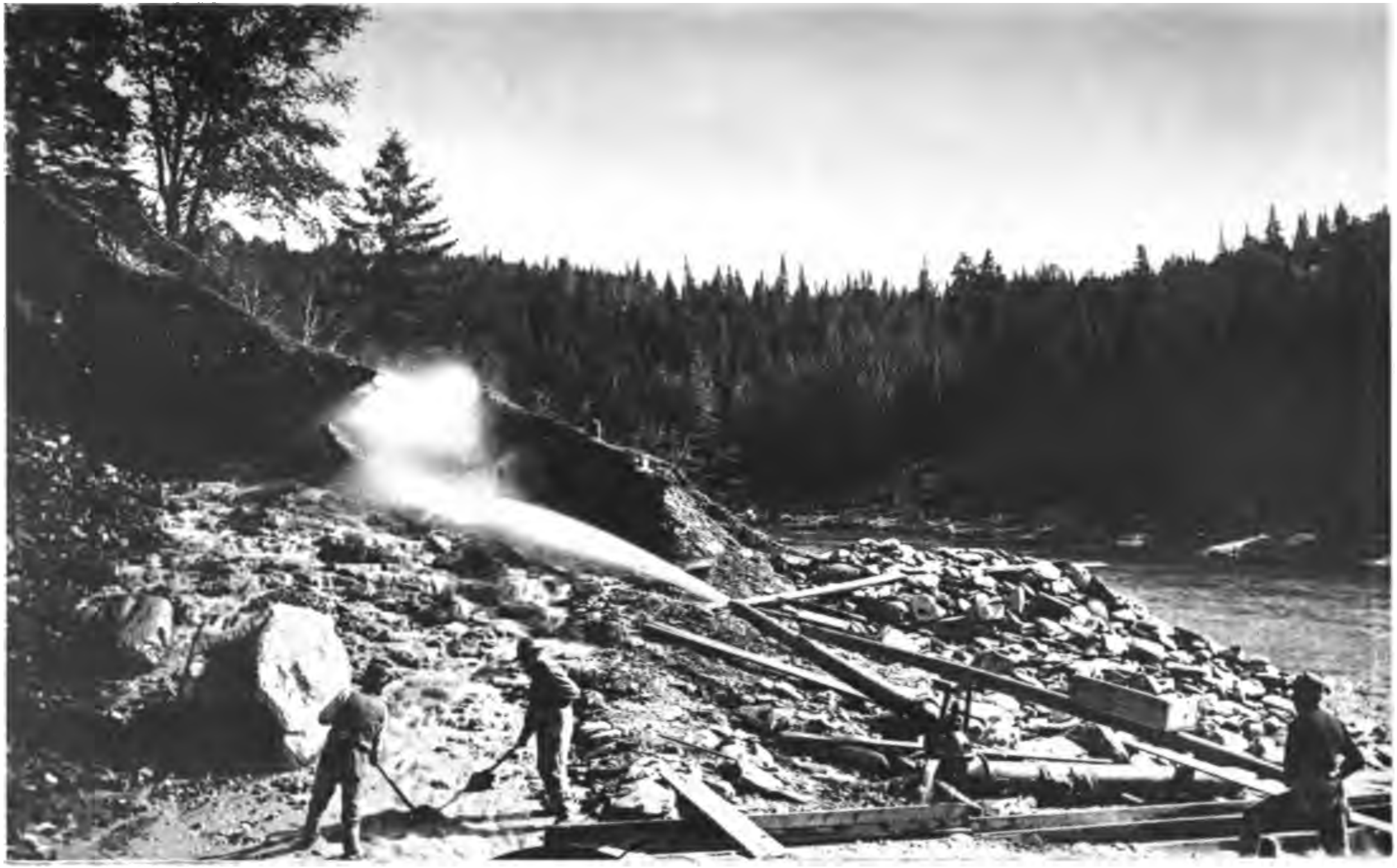
View of Hydraulic Gold washing.

The view on the opposite page is from a photograph kindly given me by A. A. Humphrey, Esq., the Manager of the works represented. Should the enterprise prove successful, there is in this region a very large field in which similar operations might be undertaken.

"On the St. John and Daquaam Rivers, to the north-east, no gold was found, though carefully looked for. This may be owing to the swampy nature of the country and the few exposures of bed rock."

Granite areas.

"In the central or southern part of the region the sedimentary rocks are interrupted by six important masses of granite and some smaller ones. The areas occupied by these vary in extent from one square mile up to 100 square miles, some of them continuing across the border into the states of Vermont and Maine, where their distribution is still more extensive. Mr. Webster says "All these granite masses appear to be of similar character and consists of white quartz, felspar (orthoclase) and black mica." The southernmost lie on the boundary between Canada and Vermont; one extends west from Bebe Plain to the east shore of Lake Memphremagog, and further west another larger mass occupies fifteen miles along the boundary from Little Leach Pond eastward, but nowhere extends more than two miles northward. To the south in Vermont it covers a very large area, extending to and beyond the Grand Trunk railway at Island Pond. All these granite areas in Canada have been already enumerated and described under the head of "Intrusive Granites" in the Geology of Canada, 1863, p. 34. The limits of the several areas in Quebec have now been traced and will be shown on the Geological map of the province. Some of these, and their extension into the adjoining states have been described in the Geologi-



Artotyped by Geo. E. Desbarats & Co., Montreal.

From a Photograph taken by Mr. A. A. Humphrey.

HYDRAULIC GOLD MINING IN THE CHAUDIÈRE VALLEY, QUEBEC.

cal reports and maps of New Hampshire and Maine,* and it is therefore unnecessary here to enter into further detail of their distribution. The stratified rocks in contact with them are everywhere more or less disturbed and altered, the limestones are converted into graphitic schists or crystalline marble and the argillites into mica slates, chiastolite and staurolite schists, and are traversed by streaks and veins (dykes ?) of granite. This kind of alteration which may sometimes be observed apparently remote from any granite outcrop, has given rise to the supposition that the fossiliferous Silurian and Devonian strata of the Gaspé Peninsula and of Maine have on their south-eastern extension passed entirely into gneisses and mica schists; or in other words, that they have there suffered an intense regional metamorphism which has not affected them to the north-east; and this idea has been strengthened by the fact that sometimes the altered rocks mentioned come into contact, or rest upon, and often closely resemble the older, (probably Huronian and in some cases perhaps Laurentian) granitoid, gneisses and mica schists. There are thus in this region two distinct groups of micaceous gneissic and granitoid rocks. The one more or less local and due to the causes which gave rise to the great so-called intrusive masses of granite, which are of Siluro-Devonian age, and the other due chiefly to the much more ancient and extended movements which produced the regional metamorphism of the Huronian and Laurentian Systems, and occurred in the Pre-Cambrian ages. Various names have been proposed for these altered rocks as, Calciferous mica schist, Lyman, Lisbon, and Montalban, names, based apparently entirely on lithological and mineralogical characters, and not on a careful investigation and mapping of the structure and succession of the formations. In describing the alteration of the limestones in the vicinity of Lake Memphremagog, Mr. Webster says:—"The contact of the granite with the limestones and calcareous slates of Silurian or Devonian age is well seen on its northern edge in the IV, V, VI, and VII. ranges of Stanstead, where there are a great number of irregular dykes cutting and tongued in with the limestone beds. The latter are much altered at and near the contact. The dykes are from half an inch to four feet in breadth, and sometimes form a network holding the altered slates and limestones in what may be called the meshes."

Two groups of altered rocks.

Contact of granite and Devonian limestones.

Unquestionable proof is thus, here and elsewhere, afforded of the age of these granites. But the extent to which they have invaded and become mixed with the more ancient Pre-Cambrian micaceous and gneissic strata has not been clearly ascertained, though that they do so is certain and might easily be studied and worked out

Age of the granites.

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* Atlas accompanying the Geological Report of New Hampshire. Geology of New Hampshire, Vol. I. 1861.

in the region south of Lake Megantic, or still more readily on the line of the Grand Trunk Railway between the townships of Barnston and Barford in Canada—where they are in contact with Silurian slates—and Island Pond in Vermont where we find them associated with a totally different set of rocks, which are probably Huronian and which there is at present no reason for separating from those which form what I have designated, the great Sutton and Danville Anticlinal—the lowest rocks of which appear in Sutton Mountain as mica schists and calcareous gneisses, often granitoid.

Post Devonian metamorphism.

The immense influence which the Devonian granite-forming epoch has had on the Pre-Carboniferous rocks of the region to the south-east of the great St. Lawrence, Champlain and Hudson River break, is certainly deserving of more careful consideration and study than it has yet received, and more especially so in connection with the alteration and metamorphism it has produced in large areas of Paleozoic, and perhaps pre Paleozoic, rocks. When these altered paleozoic strata come in contact, as they often do in Eastern Canada and in New England with the more ancient Huronian and Laurentian gneiss, granite, mica schist and other crystalline rocks, it is only possible to distinguish them or to define their respective limits by the most careful and minute stratigraphical work, such as the nature of the regions in New England and in the adjacent provinces of Canada, where these rocks are chiefly developed, renders almost impossible, or at any rate has never yet been attempted. Hence the maps hitherto published, representing the geological structure of these regions have necessarily been based almost entirely, so far as the crystalline groups are concerned, on lithological and mineralogical comparisons and considerations, producing petrological rather than geological maps, and as a consequence, though important and valuable aids to future investigation, they afford a very incorrect and imperfect idea of the true geological structure and the sequence and distribution of the several formations. Unfortunately, while careful, patient and minute observation in the field has been unavoidably limited and local, study in the laboratory and theoretical deductions therefrom have been unlimited and wide spread; but, as might have been expected, have not only afforded no satisfactory solution of the intricacies of Appalachian geological structure, but have on the contrary involved it in deeper mystery and complication. It is now evident that an entirely different system of procedure must be adopted before there will be any hope of definitely and satisfactorily solving the problems which have presented themselves to successive observers in this difficult field. On pages 577-78 of the Geology of Vermont, 1861, Dr. Hitchcock has clearly stated his conclusions respecting the age and relations of the granites and schists of Vermont. These rocks are the

Petrological maps.

Dr. Hitchcock on ages of Vermont granites.

southern extension of those of Canada to which the foregoing remarks specially refer. Dr. Hitchcock's conclusions were based on careful personal and extended examination in the field, and agree very closely with those of Sir W. Logan, and also with those of the writer whose conclusions are likewise based on similar careful examination of wide areas of Devonian granites in Australia and in eastern Canada. In these widely separated regions, whatever the causes may have been, the effects produced are identical.

Points to be investigated.

The most important points that now require investigation are:—The manner and extent in, and to which the Devonian granite-forming agencies have affected the formations which were previously in a metamorphic condition, and whether portions of the so-called Calciferous mica schists, and of the Coos groups of the New Hampshire survey which extend into Canada may not represent both palæozoic and pre-palæozoic strata of several formations, the normal conditions and character of which has been more or less affected and changed by the agencies referred to; and on the supposition that the granite itself has been formed from the rocks with which it is now in contact, to what extent it may itself differ, and show in this some constant relation to the normal differences observed in the several formations with which it is now locally surrounded. Theoretically in pursuance of this idea, the Devonian granites when in contact with Huronian rocks should materially differ from such as are in contact with the ordinary class of Devonian and Silurian sediments—hornblendic granite, syenite and other more basic forms prevailing in the former case, and the more acidic forms in the latter.

The investigations of the survey now in progress in Nova Scotia, New Brunswick and South-eastern Quebec will, it is hoped, together with the careful microscopic examinations being made by Mr. Adams, throw some light on these questions, and in the meantime it is quite useless to further speculate and theorize respecting them.

OTTAWA, May 1883.

APPENDIX.

NOTES

ON THE

MICROSCOPIC STRUCTURE OF SOME ROCKS OF THE QUEBEC GROUP.

BY

FRANK D. ADAMS.

The following notes are the result of a microscopic study of a collection of rocks from the Quebec Group submitted to me for examination by Dr. Selwyn. They are, with one exception, (that of the *Felspathic Sandstone* from Acton), from the middle and lower of the three divisions into which he has recently divided this Group,* and are, therefore, in Dr. Selwyn's opinion, probably of Lower Cambrian, or Huronian age. The nomenclature employed for the massive rocks is that of Professor Rosenbusch,† to whom my best thanks are due for much assistance kindly afforded me in this investigation.

MASSIVE ROCKS.

1. *Hornblende Granite—Shipton, Range XII., Line of lots 7 and* 8.

This rock is composed essentially of quartz, orthoclase, plagioclase and hornblende, with a little titanic iron ore. The hornblende, as is usual in granites, seldom has a good crystalline form. It is light green in colour, strongly pleochroic, shows in many places the characteristic cleavage and often occurs twinned. It sometimes contains little pleochroic "höfe" surrounding minute doubly refracting crystals. Its angle of extinction, as is often the case with the hornblende in granites, is large. The greatest angle measured was 24°, and this was in a section in the zone of the orthopinacoid and clinopin acoid nearly but not quite coinciding with the latter plane. Many of these hornblende grains assume a fibrous form at their edge, but this is especially the case at the extremities of the elongated patches in which it often occurs. The rock is no longer fresh. The felspar, of which a very considerable proportion is plagioclase, is a good deal decomposed, and the hornblende is altered in a very peculiar and apparently hitherto unobserved manner. Three stages of the alteration can be clearly distinguished. 1st. The hornblende changes to a scaly mass having all the appearance of chlorite. This zone is not always present. 2nd. There is a zone of fine needles, generally in tufts with parallel extinction, and which have a brown or yellow colour. This colour, however, probably does not belong to the needles themselves, but is due to the separation of hydrated oxide of iron on the decomposition of the hornblende molecule. 3rd. Running out from these tufts are long and exceedingly fine hair-like needles which penetrate the quartz. These are colourless and probably the same as those of the yellow zone, but longer and finer. Dr. George Williams, of Johns Hopkins University, to whom I am indebted for information on several points connected with this rock, remarks the curious fact of the "constant relation existing between the hornblende and quartz; while the edge of a hornblende crystal in contact with felspar is quite sharp and fresh, or, at most, only fibrous; the edge of the same crystal in contact with quartz almost always presents the phenomena described." Dr. Williams considers that there has been a mutual reaction of these two minerals on each other in a way exactly similar to that so often observed between plagioclase and olivine in the Scandinavian olivine diabases[*], in which cases a zone of silicates of undetermined character is formed along the line of contact between the two minerals. In this rock the yellow tufts of needles can often be seen along the junction of two quartz grains, in which case they have probably been formed by infiltration. Some quartz grains are so filled with the fine needles that they present exactly the appearance of decomposing cordierite, and might easily be mistaken for that mineral were it not for the fact that a uniaxial interference figure may be repeatedly observed. In some places the hornblende changes to a finely fibrous yellow mineral, probably chrysotile. The iron ore is present in small quantity, and is partially decomposed to leucoxene. Apatite is present in the usual long slender crystals.

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* Report of Progress, 1877-78, p. 3, A.

† Mikroskopische Physiographie der massigen Gesteine. Stuttgart, 1877.

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[*] Törnebohm—"Über die wichtigeren Gabbro-v.-Diabas Gesteine Schwedens," Neues Jahrbuch fur Mineralogie, p. 383, 1877. Törnebohm considers one portion of this zone to be composed of hornblende grains.

2. *Hornblende Granite—Orford, Range XV., Lot* 3.

Much decomposed, the hornblende, however, does not show the peculiar method of decomposition seen in the last specimen. Judging from the section, the rock must have been submitted to great pressure. The quartz grains are much broken and the section is traversed by several lines of fracture along which the constituents have been reduced to an aggregate of very small grains, and depositions of secondary minerals have taken place.

3. *Quartz—free Porphyry—Shefford, Range III., Lot* 24.

This rock occurs associated with chloritic schists, and is, so far as can be ascertained, comformable to these in strike and dip. In a section it is seen to be composed of a microcrystalline groundmass, holding numerous large crystals of felspar scattered through it. These felspar crystals have, under the microscope, a turbid appearance; they sometimes occur in simple forms, sometimes in twins, according to the Carlsbad law; and one or two of them in the sections showed an extinction parallel to a crystallographic axis, thereby proving that the felspar is really orthoclase. A few plagioclase crystals, like those of orthoclase much decomposed, but showing polysynthetic twins with very narrow lamellae, are also present in the section. No quartz crystals are present in either of the three sections of this rock which have been prepared, and it has accordingly been classed as a quartz-free porphyry, although some quartz recognizable by its uniaxial and positive character is present in the ground mass, so that, strictly speaking, it would probably occupy a position intermediate between the quartz and quartz-free porphyries, such rocks being by no means rare.* The rock is, however, a good deal decomposed, calcite being present in the ground mass, so that the quartz may be a secondary product. Disseminated through the groundmass, and in smaller amount in the imbedded crystals, there are numerous opaque black grains, generally irregular in shape, but sometimes occurring in little cubes; these are probably an iron ore. Associated with these grains, at a few places in the ground mass, there is a strongly pleochroic mineral, the colours changing from light yellowish-brown to a dark brown, and with greatest absorption parallel to a very good cleavage. Between crossed Nicols, extinction takes place when the plane of polarization of either prism coincides with this cleavage, so that the mineral is probably a magnesia mica. In a section the groundmass appears of a light brownish tint; the color being due to a yellowish-brown mineral which is finely disseminated through it, and which also occurs, though in much smaller quantity in the imbedded crystals, either in little patches or running along their cleavage lines.

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* Comp. Rosenbusch, Mikroskopische Physiographie der massigen Gesteine, p. 129.

4. *Quartz Porphyrite—Potton, Range X., Lot* 16.

The groundmass is microcrystalline. In it both plagioclase and quartz can be recognised; the former, by its polysynthetic twins, and the latter, by its axial figure. The imbedded crystals are numerous, and are principally plagioclase, sometimes showing a double set of twin lines. One or two untwinned felspar crystals are present in the sections. A few clear well-formed quartz crystals are also imbedded in the groundmass, and hold numerous cavities with moving bubbles. The felspar crystals also hold many cavities with bubbles; some of these bubbles can be seen to be in motion, while others, which are generally large in size, compared to the cavities, remain stationary. In addition to these quartz and felspar crystals, there are distributed through the groundmass, numerous masses which are apparently aggregates ot yellowish-brown rhombohedral crystals. They are composed principally of an untwinned carbonate, with yellowish-brown hydrated oxide of iron occurring around the edges of the masses as well as along the cleavage lines and in irregular shaped masses in the carbonate, which is also in some places traversed by minute acicular crystals. When a section of the rock is treated with dilute hydrochloric acid, the carbonate is dissolved out with effervescence, a portion of the oxide of iron also passing into solution. On treatment with the concentrated acid, all the oxide of iron goes into solution, leaving a dull greyish translucent mineral through which the oxide of iron had apparently been disseminated, and which on treating the etched side with fuchsine, absorbed the colouring matter and became deeply stained. The cavities, after the removal of the carbonate, are often seen to be lined with this mineral, while the minute acicular crystals which remain unacted upon by the acid, traverse them in various directions. These masses do not possess any general outline which would indicate their derivation from either hornblende or augite, although they have probably originated from the decomposition of some bisilicate. Scattered thickly through the groundmass and occurring also in the imbedded felspar crystals, there are minute lath-shaped crystals, generally ragged at the terminations. These are colourless, of a very faint greenish tint, doubly refracting; the interference colors being rather brilliant, and have a very good cleavage parallel to their length, and extinction parallel to this cleavage. When the section is treated with hydrochloric acid and then with fuchsine, these little crystals are found to have been attacked and stained. They are probably some hydrated variety of mica. A few grains of pyrite are also present in the sections.

5. *Gabbro—Between Lake Colombe and South East line of Wolfestown.*

This rock occurs associated with the serpentine. It is composed of diallage and plagioclase. The diallage is for the most part tolerably fresh, though in places it is decomposed. In addition to the prismatic cleavages, it has the usual perfect cleavage or "theilbarkeit" parallel to the orthopin acoid. In most of the crystals occurring in the section which show this cleavage, the axes of elasticity make an angle with it; but several grains were found which were cut in a direction approximating the base or an orthodome, and in which, consequently, the extinction almost or quite coincided with the cleavage. By examining the axial figure seen in such sections, the plane of the optic axes was found to be at right angles to the cleavage, thus proving that the mineral was really diallage and not a rhombic pyroxene. The plagioclase in the section is now entirely decomposed, principally to a dull translucent mass with aggregate polarization (saussurite?) Numerous very minute scales of oxide of iron are scattered through the rock.

It bears a very close resemblance to a gabbro from near the head of the Upsalquitch River in New Brunswick.

The following four rocks bear a general resemblance to one another. They are exceedingly decomposed; but little of their original constituents remaining intact. Being doubtful as to whether they should be regarded as igneous rocks, I sent sections of two of them, viz., that from Potton, Range VI., Lot 14, and that from Range X., Lot 24 of the same township, to Professor Rosenbusch, who was kind enough to examine them for me. Professor Rosenbusch gave it as his opinion, after a careful examination of the slides, that the rocks were not sedimentary, but were highly altered diabases.

6. *Altered Diabase—Potton, Range VI, Lot* 14.

The rock is very fine grained and of a dull greenish-gray colour. In my sections none of the original augite remains; in its place, there is a mixture of light green actinolite, often altered to chlorite, and some epidote. The original felspar is decomposed into a mixture of quartz, albite and calcite. The iron ore is altered to leucoxene. A little pyrite is present. Professor Rosenbusch observes that this kind of alteration is very common in the diabases, which occur in the form of beds in the metamorphic districts of the Harz, of the Rhein (Taunus), and of the Fichtelgebrige, and that the structure of the rock, which is still to be distinctly seen in places, shows that in this rock also we have an altered diabase.

7. *Altered Diabase—Potton, Range X., Lot* 24.

Very fine grained and of a dull greenish-gray color. What has been said of the last rock applies equally well to this. A large part of the actinolite is decomposed to chlorite. Some of the original plagioclase can still be recognised. A good deal of pyrite occurs scattered through the rock in cubic crystals.

8. *Altered Diabase—Potton, Range X., Lot* 12. (*Owl's Head.*)

A similar fine grained greenish-gray highly altered diabase.

9. *Altered Diabase?—Top of Adstock Mountain, Township of Adstock.*

Very fine grained, and even more decomposed than the other specimens. Consists largely of very fine fibrous light-green actinolite. Chlorite, quartz, plagioclase and leucoxene are also present in smaller amount. On treating a section of this rock with hydrochloric acid for thirty-six hours in the cold, and then with fuchsine, much chlorite occurring in little strings and patches, often running along the cleavage lines of the hornblende is seen to have been attacked and stained, while the greater part of the actinolite itself is still unattacked.

The hand specimen is traversed by small veins of white quartz. It is probably like the other three, a much decomposed diabase.

10. *Diorite—Adstock Mountain.*

A second specimen bearing the label Adstock Mountain.

It is rather coarsely crystalline, massive, and of a greyish-green colour, and is composed of hornblende and plagioclase. The hornblende is green or in some places brownish in colour, and is distinctly pleochroic. It is recognised by its biaxial character, its well marked cleavages, cutting one another at an angle of about 124°, and its small extinction angle of about 16°. It is often twinned. Much of the hornblende is decomposed to chlorite. In many cases the alteration appears to pass through an intermediate stage in which the hornblende assumes a very finely fibrous appearance. The fibres are generally approximately parallel, but do not as a general rule extinguish simultaneously. Individual fibres can often be seen to have an extinction inclined at a small angle to their longer axis. Some of these fibrous grains. show a distinct biaxial figure. The plagioclase is dull from incipient decomposition, but generally shows well defined polysynthetic twins, of which two sets are frequently present crossing one another. Although the two minerals have interfered with each other in crystallizing, both show in places good crystal forms. The felspar is perhaps upon the whole the better crystallized of the two. On treating an uncovered section with hydrochloric acid for an hour and a half, and then with fuchsine, decomposition products, occurring both in the hornblende and plagioclase in little strings and spots were found to have been acted on and stained. On treating the section with the acid for thirty hours longer, the undecomposed hornblende was still quite unacted on, but many of the hornblende crystals which had been, as above mentioned, altered wholly or in part to chlorite, were found to be stained by the fuchsine. The fibrous hornblende was found to be everywhere much mixed with chlorite.

CRYSTALLINE SCHISTS AND SERPENTINES.

The following five rocks resemble one another in composition, but present structural differences. They are evidently closely allied to a set of rocks from the Huronian series in the region south of Lake Superior described by Dr. Wichmann, and classified by him under the general heading, "Felspathic hornblende schist and rock." *

In these rocks from the Quebec group, however, the hornblende is almost invariably present in the form of actinolite, while in those from Lake Superior, it apparently as a general rule occurs in the ordinary prismatic form. It has recently been stated that the chlorite schist associated with the diorite at Dobschau, in Hungary, and out of which the latter is supposed to have been produced, has a micro-crystalline groundmass of a felspathic nature. The felspar of this groundmass is judging from flame reactions pretty rich in soda. †

These Canadian rocks are regarded by Dr. Selwyn as altered contemporaneous volcanic rocks.

11. *Felspathic Actinolite Schist—Pinnacle Mountain—East St. Armand.*

When a section of this rock is examined with the naked eye, it is seen to consist of a number of more or less rounded masses of an almost colourless transparent mineral, averaging about 0.1 inch in diameter, together with a few large magnetite crystals, imbeded in a green groundmass. When examined under the microscope these rounded masses are seen to consist, as a general rule, of a single crystalline individual, but often, especially in the larger ones, two or even more individuals are present. Each of these individuals contains a multitude of greenish inclusions, giving to the mineral, which is itself colourless, a green colour when seen in small fragments. These inclusions are heaped up in the central portion of the crystals, leaving a narrow zone immediately around the edge with comparitively few. When one of these rounded masses contains more than a single crystal, each individual has a heaping up of the inclusions about its own centre, leaving the lines of contact comparatively free from them, thus making it in many cases possible to distinguish the various crystals without the aid of polarized light. The inclusions are principally of two minerals. One occurring in irregular shaped, often elongated grains, with the high index of refraction, brilliant interference colours and characteristic pleochroism of epidote. The other generally in narrow elongated crystals with cleavage parallel to their long axis, and an extinction making a small angle with this cleavage, and which are actinolite. The colourless mineral itself is very clear and free from decomposition, when cut approximately perpendicular to an optic axis it always shows the revolving bar of a biaxial crystal, and many of the crystals show a set of parallel cleavage lines, sometimes crossed by a second less perfect set with an inclination varying with the direction of the section. Most of the crystals are untwinned, a number however show twins composed of two differently orientated parts, and some exhibit the polysynthetic twins of a plagioclastic felspar. It is therefore felspar, triclinic certainly in part and perhaps altogether. The impure felspar fuses at a little over 4, giving a strong soda flame. The green groundmass consists of actinolite crystals with epidote, a brown strongly dichroic mica, a small quantity of chlorite, and here and there a little quartz, distinguished from the felspar by its uniaxial character. The magnetite crystallizes in octahedra, generally very perfect in form, and occurs in the groundmass, often however penetrating into the felspar crystals. The rock also contains a considerable amount of calcite in large grains associated with, and sometimes occurring as an inclusion in the untwinned felspar. A section was treated with concentrated hydrochloric acid for an hour and a half without warming, the calcite having been previously removed by treatment with dilute acid. The magnetite was dissolved out and the brown mica somewhat acted on. By a longer treatment with the acid (thirty hours), all the mica, as well as the chlorite was etched, but all the other constituents were apparently quite untouched.

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* "Microscopical observations on the iron bearing (Huronian) rocks from the Region south of Lake Superior—Arthur Wichmann Ph. D."—Geology of Wisconsin, vol. III. p. 641.

† "Daten über den Diorit von Dobschau"--Ladislaus Nagy. (Földtani Közlöny 1880, X, 403). Noticed in the Neues Jahrbuch für Mineralogie, etc., I, 2, 1882, p. 236.

An attempt was made to separate the constituents of the rock using a solution of iodide of mercury in iodide of potassium, and thus ascertain by means of specific gravity whether more than one species of felspar was present. The magnetite, epidote and actinolite were easily obtained in an almost pure state, but the felspar was found to contain so many inclusions that it was impossible to obtain good results. Although the grains were of such a size that they passed through a sieve with 80 meshes to the linear inch, it was found that had they been half this size very few would have been free from the inclusions.

The rock has a green colour and in the hand specimen a rather distinct schistose structure.

12. *Felspathic Actinolite Schist—Sutton, Range II., Lot* 1.

Identical with the Pinnacle Mountain rock in almost every respect. Magnetite is however wanting in the sections, nor can any be seen in the hand specimen, and more quartz is present, occurring in the green groundmass, in aggregates of small clear uniaxial grains. The felspar masses are also somewhat larger, and the individual crystals of felspar even more crowded with inclusions. Many of them show lines of polysynthetic twinning.

13. *Felspathic Hornblende Schist—Top of Bear Mountain—Potton, Range XI., Lot* 2.

Consists of numerous felspar individuals together with some of hornblende, and of a greyish translucent mineral, imbedded in an aggregate of smaller grains. The felspar is often well crystallized. Almost every grain is twinned, the majority of them showing polysynthetic twin lines. As in the case of the last two rocks, they hold inclusions, which however are not so numerous and are very small. These are probably epidote and actinolite as before, but little bunches of a yellowish micaceous mineral are also present. It is therefore certain that in this rock a large proportion of the felspar is plagioclase, and I am inclined to think that the whole of it really belongs to a triclinic species. The hornblende is of a light green colour, and shows the characteristic cleavages, cutting one another at an angle of about 124°, and has a small angle of extinction. The large individuals often terminate in a bunch of fibres. The greyish translucent mineral above mentioned occurs in masses which are generally irregular in shape, and often elongated in the direction of the plane of foliation. They sometimes, however have a rude rhombic outline. On the thin edges where it is transparent, it is seen to be made up of minute rounded grains with high index of refraction and showing brilliant interference colours. They resemble some forms of leucoxene, a decomposition product of titanic iron ore which is in some cases at least, a form of the mineral sphene. A qualitative chemical examination of the rock was made, and a distinct reaction for titanic acid obtained, so that the mineral may be referred to this species. The finer grained aggregate in which these larger individuals are imbedded. consists of hornblende, generally in the form of actinolite, together with felspar, quartz, and chlorite. A mineral occurring in small irregular shaped brown leaves with elongated cross sections and often in the form of little bunches is also present. It is uniaxial and negative. The cross sections exhibit strong dichroism with almost total absorption of light passing through them parallel to their longer axis. It is therefore a mica probably allied to biotite. It is intimately associated with the hornblende. A good deal of epidote, together with a little pyrite and hematite also occur in small grains. The rock being schistose, a rude parallelism in the arrangement of the constituents is often to be seen in the sections. This is shown very well in the case of its long hornblende crystals which frequently curve around the felspar crystals giving an appearance somewhat resembling flow structure, and which is in many cases to be observed in crystalline schists, notably in the porphyroids.

14. *Felspathic Actinolite Schist—Stuckely, Range VII, Lot* 6.

A fine grained greenish-gray schist composed principally of felspar and actinolite, with a good deal of chlorite. The felspar is in the form of small clear biaxial grains, generally untwinned but often showing polysynthetic twinning, and forms a sort of groundmass of the schist, being frequently penetrated by the actinolite crystals. Large crystals of epidote and a large quantity of iron ore in irregular grains are scattered through the rock. The latter are usually much elongated in the direction of the foliation of the rock, and sometimes on very thin edges are seen to be transparent and of a deep red colour. This iron ore differs very much from that contained in the rock from Pinnacle Mountain, not only in its want of good crystalline form, but in the difficulty with which it is attacked by hydrochloric acid. The magnetite in the sections of the Pinnacle Mountain rock was entirely dissolved by treatment with concentrated hydrochloric acid for an hour and a half in the cold. The iron ore in this rock was but very slightly acted on by treatment with the acid for sixty hours in the cold, but was dissolved when the section was treated with hot acid for two hours. It is probably an ore rich in titanium, as numerous little bunches of irregular rounded grains of mineral resembling sphene are scattered through the rock and frequently clustered around its irregular shaped grains. The constituents of the rock generally have a parallel arrangement, and frequently in different layers one or other constituent predominates. The rock also contains irregular shaped secretions, giving to it a sort of amygdaloidal apppearance and which stand out from the weathered surface.

They have a more or less rounded outline, in a section are seen to have pretty well defined walls and are frequently elongated in the direction of the plane of foliation. Some of these are composed of chlorite and a triclinic felspar, while others hold well-crystallized epidote which frequently predominates to the almost total exclusion of the other constituents. The chlorite occurs in bunches of leaves arranged parallel to one another, or in radiating masses. The felspar sometimes assumes sheaf-like forms and presents a turbid appearance under the microscope, due to numerous small blackish inclusions and minute cavities. The felspar from one of these secretions, fused at about 4 to a transparent globule, giving a strong soda flame.

15. *Felspathic Actinolite Schist—Bolton, Range V, Lot* 28.

Very similar to the last rock, consisting principally of actinolite, felspar and epidote. The felspar, as before, forms a sort of groundmass, of very clear grains, sometimes showing polysynthetic twin lines. Although some of these grains look very much like quartz, I have not been able in a single instance to prove the presence of this mineral in the rock, since these grains whenever properly cut show the revolving bar of a biaxial crystal. The actinolite occurs in the form of long slender crystals, either separate or aggregated to mat-like masses, in which cases a little chlorite is also present. A small quantity of well-crystallized magnetite is present in the rock, and is much more readily attacked by the hydrochloric acid than the iron ore in the specimen from Stuckely, being completely removed from the section by treatment with the acid for thirty hours.

16. *Felspathic Hornblendic Schist—Bolton, Range XI, Lot* 3.

This rock is very distinctly foliated, consisting of thin alternate layers of a greyish and of a brownish colour.

The darker layers consist of irregular shaped grains of brown hornblende with a small quantity of felspar. The light coloured layers consist of felspar, with grains of clear green augite, and a little hornblende. Leucoxene, often with a core of ilmenite, also occurs in the rock, principally in the light coloured layers. The minerals do not possess good crystalline form. The hornblende is strongly dichroic and shows the cleavages characteristic of hornblende crossing one another at an angle of about 124°. The felspar is colourless, often a good deal decomposed, and generally untwinned, in many places, however, polysyntheic twin lamallæ can be seen. In sections the rock is seen to be traversed by numerous little faults running in a direction approximately at right angles to the foliation. Dr. Selwyn supposes this rock to be an altered tuff, and its microscopic characters do not oppose this view.

17. *Gneiss—Island in Lac Noir, Township of Coleraine.*

This rock is composed of quartz, orthoclase, plagioclase and a very light coloured mica. Both the quartz and felspar grains are much broken, faulted and twisted. The mica occurs in irregular strings and curved crystals, having a rudely parallel direction, and generally running between the quartz and felspar grains, it also occurs as a scaly crypto-crystalline aggregate. It has one very good cleavage with extinction parallel to it, in some crystals no pleochroism can be observed, in others light passing through in a direction parallel to the cleavage assumes a very faint reddish tint, while that traversing the crystal at right angles to the cleavage has a very faint greenish tint. In some places it holds the pleochroitic "höfe" before mentioned as occurring in the hornblende of the granite from Shipton. It is perhaps some hydrated potass mica, and in many cases looks as if it were a secondary product. Although not a typical specimen of the species, the name gneiss is perhaps the most fitting for this rock.

18. *Serpentine—Range* 11. *Rivière des Plantes.*

The section of this serpentine contains a few remains of a rhombic pyroxene. These are slightly pleochroic, and have one very good cleavage to which the extinction is always parallel. Numerous little black needles are also inlaid parallel to this cleavage. In one or two cases where the mineral was cut perpendicular to an optic axis, the plane of the optic axis was found to be parallel to the cleavage, showing that these remains are really rhombic pyroxene and not diallage. This serpentine is therefore the product of the alteration of some rock of which a rhombic pyroxene was a constituent.

19. *Serpentine—Melbourne.*

The rock is of a dark green colour. In examining sections of it the alteration to serpentine was found to be complete, with the exception of a few irregular shaped remnants which occur in one of them. These have a well marked cleavage, or rather fibrous structure, in one direction with extinction parallel to it, and (the section being a thick one) a well marked pleochroism, the light passing through parallel to the cleavage being green, and that passing it at right angles to it of a reddish colour. They are probably bastite or some allied mineral derived from the alteration of a rhombic pyroxene, which was a constituent of the rock from which the serpentine was derived.

CLASTIC ROCKS.

Of the following rocks the first is a true grauwacke, as the term is used in Germany, and although some of the others, notably, Nos. 25, 26, and 27, differ from it in several respects and might perhaps be more properly classed as highly felspathic sandstones, I have retained the name grauwacke in the case of Nos. 25 and 26, placing after it the name highly felspathic sandstone, and mentioning in the short description wherein they differ from grauwacke proper.

20. *Highly Felspathic Grauwacke—Potton, Range* VIII. *Lot* 15.

When a thin section is examined this rock is seen to be composed of numerous fragments of minerals, together with some rock fragments, united by a small quantity of a micro-crystalline cement. Many of these fragments are of quartz, these are generally angular, but sometimes somewhat rounded. A few of felspar, both orthoclastic and plagioclastic, are also present. There are also a large number of grains which are now decomposed to an aggregate, but which were originally felspar, since here and there a felspar grain may be seen partially decomposed to a similar aggregate. The quartz grains are not very rich in inclusions but sometimes hold the hair-like bodies often seen in the quartz of granites. A good deal of calcite, evidently a decomposition product, is scattered through the rock in little grains and strings. In addition to these mineral fragments there are a number of fragments of a very dark coloured, fine grained rock. These are very irregular in shape, sometimes much elongated, and often have a schistose structure. Between crossed nicols they are seen to be in places isotrope and elsewhere very feebly, doubly refracting, but contain little doubly refracting microlites as well as numerous opaque black granules. They are often penetrated by lath-shaped crystals of a mineral which is opaque or almost so, but by reflected light is of a dull yellowish colour and without metallic lustre. They also occasionally hold pyrite. These are fragments of a very fine grained grauwacke schist, and of argillaceous quartzite. The cementing material is probably derived partly from the decomposition of the felspar fragments, and is in part a product of the alteration of what was originally a muddy material deposited with the grains.

Most of the sections of this rock also contain minute crystals of zircon. These are in the form of square prisms, often terminated at one end by an obtuse pyramid. They are colourless, have a high index of refraction, polarize in brilliant tints and have an extinction parallel to the prism. On the square basal section they show the cross of a uniaxial crystal, which when tested with a quarter-undulation plate proves to be positive in sign. These zircons are sometimes without good crystalline form. Nearly all the sections also contain small oblong crystals of a brown or green colour. These are traversed by transverse cracks, have an extinction parallel to their long axis, and are dichroic, the greatest absorption taking place when the light passes through the crystal in a direction at right angles to the long axis. The ends of the crystals are irregular, in the larger crystals one end being almost invariably terminated by a somewhat fibrous development of the crystal, often lighter in colour than the remainder. These are tourmaline crystals. Grains of pyrite and minute crystals, probably apatite, are also present in most sections. A section of this rock was treated with concentrated hydrochloric acid for twenty-four hours and then with fuchsine. The rock fragments were unacted on with the exception of one in which numerous little points were found to be slightly coloured. The dull yellowish crystals penetrating them were also unacted on. Some of the decomposed felspar fragments were slightly but distinctly coloured, while the other felspar grains and the cementing material were unattacked.

Professor Rosenbusch, to whom I sent sections of this rock, states that it is similar to the felspar rich grauwackes which occur in the Vosges, for example, in the Devonian and Carboniferous, chiefly in the metamorphic districts designated by the older French geologists as the "terrain de transition modifié."

21. *Highly Felspathic Grauwacke—Shipton, Range VI. Lot* 11.

Resembles the last rock. The fragments in this rock, however, consist almost exclusively of felspar. They are more or less angular, the plagioclase grains being at least as numerous as those of orthoclase. Quartz grains are very few in number, if indeed any are present in the sections. A light green mineral is disseminated through the sections of this rock in strings and irregularly shaped patches. It is often pleochroic showing light green and greenish-yellow tints, and between crossed nicols shows aggregate polarization, with dull blue tints. It often occurs in little leaves and radiating spherulitic masses, and in some of the larger leaves a fibrous structure can be seen, in which cases extinction takes place parallel to the fibres. It thus has under the microscope the characters of a chloritic mineral, and has undoubtedly originated in great part at least from the alteration of the felspar, since in many places in the slides little vermiform processes of the mineral can be seen penetrating, well twinned plagioclase grains, and in some cases untwinned grains which are probably orthoclase. The alteration of plagioclase and orthoclase to a chloritic mineral (pseudophite) has already been described from several localties.* Numerous grains of leucoxene resulting from the decomposition of iron ore are also present.

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* See Justus Roth—Allgemeine und Chemische Geologie, pp. 305 and 321.

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22. *Highly Felspathic Grauwacke—Shipton, Range VI. Lot* 12.

Similar to the last mentioned rock from lot 11 of the same range. A very few quartz fragments are present in the sections.

23. *Highly Felspathic Grauwacke—Shipton, Range VI. Lot* 13.

Similar to the last two, but contains in addition to felspar fragments, a large proportion of angular quartz grains, as well as a few decomposed fragments of what was probably some rock. It shows evidence of having been submitted to great pressure. The quartz grains are much broken and in some places converted into a mass of rice-like grains. Very few of them extinguish simultaneously over the whole surface. They are, moreover often of an elongated shape, being sometimes as much as seven times as long as they are broad, which is unusual in ordinary clastic fragments of quartz. Those elongated fragments however occur with others not so elongated. The felspar grains as is the case in most of these rocks are much bent and faulted, phenomena which can be plainly seen in the plagioclase grains on account of their lines of twinning. Leucoxene occurs in numerous small irregular shaped masses, often with a core of undecomposed iron ore. Little folia of chlorite and of a colourless mica, together with little grains of epidote showing a high index of refraction and the usual pleochroism occurs in the cementing material.

24. *Highly Felspathic Grauwacke—Lac au Crapaud—Rolette, Range III. Lot* 7.

Resembles the last rock very closely, but does not contain any of the elongated quartz grains present in it. The quartz grains hold numerous hair-like bodies, and fluid inclusions, with moving bubbles. The cementing material contains a large quantity of a green chloritic mineral together with an almost colourless micaceous-looking mineral (muscovite?)

25. *Highly Felspathic Grauwacke or Sandstone—Between 2nd and 3rd south-west road. Augmentation of St. Michel.*

A rock composed of more or less angular grains of quartz, orthoclase, plagioclase and an iron ore, the latter partially decomposed to leucoxene cemented together by a small amount of a green chloritic mineral A few decomposed fragments of what was probably some rock are also present. The felspar grains are as numerous as those of quartz, and a few of them show the cross hatched structure usually seen in microcline. The cementing material in this rock is, as has been stated, a chloritic mineral, and is much smaller in amount than in most of the specimens before described.

26. *Highly Felspathic Grauwacke or Sandstone—River St. Anne, Shickshock Mountains.*

Resembles the specimens from Lac au Crapaud and Shipton, Range VI, lot 13, in composition, but is much fresher. Comparatively little of the chloritic mineral occurring in large quantity in both of these rocks is present. The cementing material is smaller in quantity, and is rich in the colourless micaceous mineral before mentioned. Much calcite in large grains is scattered through the rock, the hand specimen has a reddish tint due to disseminated hematite grains.

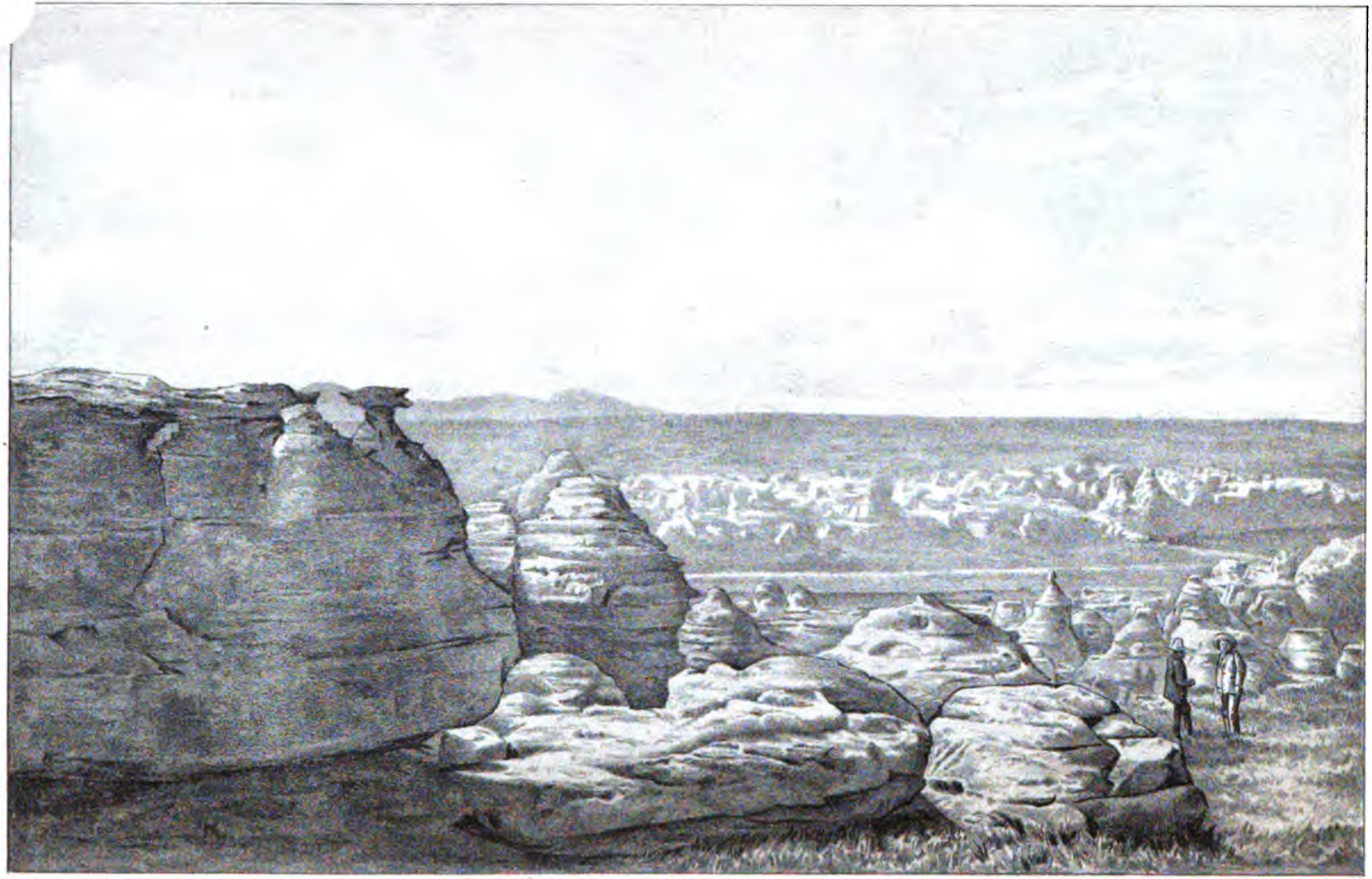
27. *Highly Felspathic Sandstone—Acton—Range XI. Lot* 36.

It is quite fresh and consists of fragments of quartz, orthoclase and plagioclase, held together by a very small quantity of a cementing material which appears to be partly microcrystalline and partly crypto-crystalline. This cement holds innumerable little red scales of hematite. The quartz grains preponderate, they are as a general rule angular, but a few are well rounded. Some hold numerous inclusions, while others are almost free from these. A number of other grains are seen in these sections, which are now decomposed to a chloritic mineral, but which were probably mica. A few little grains of tourmaline, epidote and sphene (?) are also present, as well as a good deal of hematite scattered through the section in irregular shaped masses.

28. *Felspathic Quartz Schist—Melbourne, Range VIII. Lot* 6.

This rock is seen by examining a section to consist of quartz grains, almost invariably angular but occasionally somewhat rounded, with a few of plagioclase and of a felspar which does not show any lines of twinning. Between these larger grains there are a great number of smaller ones of the same minerals. The rock is distinctly foliated, the plane of foliation being marked by little irregular strings and patches of a chloritic mineral. The quartz grains which preponderate very largely, generally hold hair-like inclusions, and some of them hold fluid cavities with moving bubbles. It is probably a clastic rock.

GEOLOGICAL SURVEY OF CANADA.



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A. Mortimer, Lith. Ottawa.

WEATHERED SANDSTONE ROCKS, MILK RIVER.

GEOLOGICAL SURVEY OF CANADA.

ALFRED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR.

PRELIMINARY REPORT

ON THE GEOLOGY OF THE

BOW AND BELLY RIVER REGION,

N. W. TERRITORY,

WITH

SPECIAL REFERENCE TO THE COAL DEPOSITS.

BY

GEORGE M. DAWSON, D.S., F.G.S.,

ASSOCIATE ROYAL SCHOOL OF MINES.

PUBLISHED BY AUTHORITY OF PARLIAMENT.

Montreal:
DAWSON BROTHERS.
1883.

To Alfred R. C. Selwyn, Esq., LL.D., F.R.S., F.G.S.,

Director of the Geological and Natural History Survey of Canada.

Sir,—I beg to present herewith a preliminary report on the Bow and Belly River District, with special reference to the Coal deposits. A more detailed account of the region, with a geological map, is in course of preparation, and will be ready for issue in the next annual volume

I have the honour to be,

Sir,

Your obedient servant,

GEORGE M. DAWSON.

Ottawa, Jan., 1883.

PRELIMINARY REPORT

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GEOLOGY OF THE BOW AND BELLY RIVER REGION, N. W. TERRITORY,

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SPECIAL REFERENCE TO THE COAL DEPOSITS,

BY

GEORGE M. DAWSON, D.S., F.G.S.,
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In submitting the following report, I may state that it is essentially a reprint, with additions and corrections, of a note published in May, 1882. This note was issued in advance of the ordinary annual report, on account of the importance of the coal deposits of the district, in connection with the rapid progress of settlement in the North-west Territory; the stage at which the examination of the district had then arrived having enabled the question as to its coal supply to be decided in the most favourable sense, and even rendered it probable that fuel for a large area of the North-west Territory may in the near future be derived from it.

Work embraced in this report.

As originally printed, this report embraced the result of my own work and that of my assistant, Mr. R. G. McConnell, B.A., in the summer and autumn of 1881. During the past season (1882) Mr. McConnell has continued the exploration of the same region, and some additional notes, the result of his work, are now incorporated. A map, on the scale of eight miles to an inch, which is intended to embody all the necessary details of structure, is now in course of preparation, and as this will be accompanied by a somewhat detailed description of the geology of the region, it is intended in the present report to give merely a short preliminary sketch of the stratigraphical relations of the beds, in so far as this is intimately connected with the occurrence of the coal seams.

OUTLINE OF THE GEOLOGY OF THE REGION.

Limits of region.

The region embraced in this report, and of which the examination and field work for mapping has now been almost completed, extends from the Rocky Mountains eastward to the 111th meridian; is bounded to the south by the 49th parallel, stretches northward some distance beyond the 51st parallel, and embraces, to the east of the Palæozoic rocks of the mountains, over 20,000 square miles. It forms the southern part of the newly-created district of Alberta, and is drained chiefly by the Bow and Belly Rivers and their tributaries, though a portion of it lies in the Missouri basin and is drained by the Milk River.

Explorations in Rocky Mountains.

A portion of the Rocky Mountains has also been explored and mapped; but as the mountainous district must form the subject of a separate investigation, it will be necessary to state here, merely, that the South Kootanie Pass, the Crow's Nest Pass, and the eastern portion of the Bow River Pass, were the districts particularly examined. The most interesting feature of these explorations was the discovery that in the region of the Crow's Nest Pass, wide valleys based on Cretaceous rocks occur west of the first range, which is formed of the Palæozoic limestones, and that, in the Cretaceous rocks, an important intercalation of volcanic material appears, in connection with which traces at least of copper ores occur. It is possible that in some of these now isolated troughs of Cretaceous rocks, coal beds may yet be found, in the heart of the range. The existence of a seam was indeed reported about twenty miles west of the summit of the Crow's Nest Pass, but the locality has not yet been examined.

General attitude of rocks.

The rocks of the foot-hills and plains east of the mountains, are, so far as ascertained, entirely of Cretaceous and Laramie* age, overlain by boulder clay and other beds referable to the glacial period, and by alluvium. In the eastern portion of the district they are horizontal or very nearly so, being frequently affected by light undulating dips scarcely greater than may be supposed to have characterized the original surface of deposition. On approaching the base of the mountains this uniformity suddenly ceases, and the beds become more or less sharply corrugated, the disturbance being in some instances so great as to result in overturned folds. The belt of country affected by this disturbance constitutes the foot-hills. The exposures of the newer rocks nearest the actual margin of the Palæozoic, very often show comparatively light south-westerly or westerly dips toward the base of the mountains. A series of great faults with downthrow eastward must separate these newer rocks from those of the mountains, and it is by a repetition of similar faulting in the mass of the range, that the isolated areas of Cretaceous rocks already alluded to have been introduced.

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* The term *Laramie* is used in a general sense for the Upper Cretaceous or Lower Eocene beds which overlie the Fox Hill Series (Cret. No. 5). It is not intended by its use to differentiate the beds so named from those of the Judith River and Fort Union series, with which they may be found to blend as the intervening district is more completely explored.

Width of disturbed belt

On the Bow River Valley, the width of the disturbed belt from the edge of the Palæozoic (which here falls back some miles from its general line) is about twenty-seven miles, on the Highwood River and its tributaries seventeen miles. On the North Fork of the Old Man it is about twelve miles in width, and on the southern branches of the same stream, including Mill and Pincher Creeks, about thirteen miles. On the Waterton (Kootanie), Belly and St. Mary Rivers, about eighteen miles. In the last named district, the limit of the belt of disturbed rocks, which has before run southward nearly parallel to the base of the main ranges of the mountains, changes its direction, in conformity with that of the mountains, to south-east. An approximate uniformity in the width of the region of upturned strata is thus maintained.

Change of composition near mountains.

Besides the disturbance above alluded to, the geology of the region in the immediate vicinity of the mountains is further complicated by the fact that the beds there change considerably in lithological character, the change being such as might be expected to occur on the approach to a shore line. Sandstones are much more abundant and coarser in texture, and in a few places conglomerates holding pebbles derived from the mountains, occur. One of the most abundant materials in these coarser rocks is the chert which is derived from concretions and irregular layers in some parts of the limestone series.

Great synclinal.

In the Belly River region, east of the belt of disturbed rocks above defined, the Cretaceous and Laramie beds form a broad, shallow synclinal, the centre of which is occupied by the Porcupine Hills. A series of reddish and purplish clay beds, which may be named provisionally the Willow Creek series, appears to be very persistent in the Laramie of this region, and affords the means of recognizing a definite horizon over a large tract of country. The width of the synclinal just alluded to, on the Old Man River and its tributaries—measuring from the base of the Willow Creek series on each side—is about forty miles. In proceeding eastward from this synclinal to the boundary of the district embraced in the season's work, the series is, generally, a descending one. The beds appear to have, as a rule, persistent light westerly or south-westerly dips, while the rivers have a considerable eastward slope; and though, as above stated, many minor undulations affect the nearly horizontal rocks of the plains, these are usually so light as to interfere little with their uniformity on the large scale. One important exception only has been noticed to this rule, where, a few miles above the mouth of the Belly, on the Old Man River, the estuarine and marine beds characteristic of the base of the Laramie are upturned at

Nearly horizontal beds.

angles of from 30° to 43°. Similar abrupt local disturbances are occasionally found in the west—as in several instances on the Missouri River —in connection with the intrusion of volcanic rocks, but there is no evidence here of such cause.

General arrangement of beds.

The general arrangement of the rocks may be represented as in the subjoined table, the subdivisions being in descending order. No attempt is at present made to state the thickness of the several subdivisions, as the map work and sections are not yet sufficiently advanced to render it possible to do so with an approximation to accuracy:—

LARAMIE.	Beds of the Porcupine Hills. chiefly thick-bedded sandstones, some shales.
	Willow Creek beds. Reddish and purplish clays, with grey and yellow sandstones.
	St. Mary River series. Sandstones, shales and clays of general greyish or greyish-green colours.
	Yellowish sandstones and shaly beds, with a mingling of fresh-water and brackish or marine molluscs.
FOX HILLS.	Yellowish sandstones, with some shales, irregular in thickness and character. Molluscs all marine.
PIERRE.	Blackish and lead-coloured shales, with occasional sandstone intercalations, especially toward the mountains.
NIOBRARA ?	Belly River series. Sandstones, shales and sandy clays, generally of pale greyish tints. Marine and fresh water fossils.
	Series apparently underlying the last on the Bow and Belly, but on the stratigraphical position of which some doubt yet remains owing to the resemblance of its estuarine fauna to that of the Judith River. Brownish and yellowish sands and clays.

So far, no reason has been found to suppose that any Tertiary rocks newer than the Laramie have been found in this district, or indeed in any part of the Canadian North-west Territory.

Porcupine Hill series.

The beds typically developed in the Porcupine Hills have been examined by Mr. McConnell during the past summer. They consist chiefly of massive and often current-bedded sandstones, with occasional shaly layers. The beds seen on the upper part of the Bow River, near Calgary, doubtless represent the same stage in the Laramie. The thickness of beds shown in the Porcupine Hills is probably several thousand feet.

Willow Creek series.

The relation of the Willow Creek series to the wide synclinal of the Porcupine Hills has already been referred to. The beds of this series are generally soft, and their outcrop follows the wide low valley which bounds the southern part of the Porcupine Hills to the west, and crossing Pincher Creek at the Police farm, runs south-eastward to the Waterton (Kootanie) River. In the vicinity of the upper part of Milk River, however, they are almost horizontal, and form the higher parts of the western portion of the plateau known as the Milk River Ridge. They also stand up prominently in the Belly Butte, near the confluence of the Belly River with the Waterton. The characteristic colouring and appearance of these beds constitute the only reason for giving them a separate provisional name, as they appear to be perfectly conformable with those above and below. Small, irregular, clayey nodules of peculiar appearance abound in some layers. Fossils are remarkably scarce, though a few fresh-water molluscs, similar to those of the underlying series, have been observed; and on the Old Man River, a few miles below the mouth of Willow Creek, the remains of a large chelonian were met with. These beds were not recognized on the Highwood or Bow Rivers, a fact not implying any break in the sequence of the Laramie formation there, but merely the absence of the peculiar colour, which enables the Willow Creek series to he defined in the southern part of the district.

St. Mary River series.

The rocks which may be designated the St. Mary River series, cover a large portion of the region under description. They have been carefully examined at many different localities, and extensive collections of fresh-water molluscs, many of which are identical with those found in the Fort Union. Judith River and Laramie beds of the western states, have been made from them. These rocks are shown in excellent sections for many miles on the Upper Belly River, and the St. Mary, Waterton and Old Man Rivers and Pincher Creek. They are generally characterized by rapid alternations of sandstones and shaly or clayey beds, the stratification, as a rule, being regular. Greyish or greenish- or bluish-grey tints characterize the beds, though some of the sandstones weather to yellowish colours, and ironstone nodules are of frequent occurrence. At the base, these rocks show estuarine and marine conditions, and yellowish colours prevail. These latter beds have been separately designated in the table of formations, but there is probably no distinct character by which they may be separated from those above, except the passage from brackish-water to fresh-water conditions. The close relations of these with the upper beds is further illustrated by a section on Bow River, described below. In these transition beds, in the Belly River region, *Corbicula pyriformis, Corbicula occidentalis* and *Ostrea* are found in some layers in great abundance.

Passage beds.

These fossils were observed in several places on the Upper Belly and St. Mary Rivers, and also on the Old Man River at the point already mentioned as showing a peculiar disturbance of the beds. The same zone runs northward to the Bow River and beyond, and at Scabby Butte includes large numbers of bones of dinosaurians.

Thickness and extent of the Laramie.

The whole of the beds so far described have been included under the general name of Laramie. The total thickness of the formation in this region is very great, several thousand feet at least, and much in excess of that of the Judith River beds as developed on the Missouri. Northward, on the Bow River, as the Willow Creek beds cannot be identified, it has been found impossible to carry out the subdivision which may be usefully retained for the region about the Belly and its tributaries. On the Bow, the Laramie extends continuously from the edge of the disturbed rocks of the vicinity of the mountains to a point about ten miles below the Blackfoot Crossing—a distance of over eighty miles. At the western edge of this region, the beds in their colour and general appearance closely resemble those of the typical St. Mary River subdivision, but eastward, sandstones predominate over shales and clays, the rapid alternation of beds differing lithologically is less marked, and the bluish and greenish-grey tints before observed are replaced by yellowish-grey and buff. The representatives of the brackish or marine beds described in the Belly River region were seen only near the eastern edge of the formation on the Bow. In a scarped bank about ten miles above the Blackfoot Crossing, the lowest layers near the river level are full of specimens of *Corbicula occidentalis* and a species of *Ostrea*, while a few feet higher, beds of similar lithological character, and perfectly conformable, are charged with *Unio* and *Vivipara*, and contain no brackish or marine forms.

Coal-bearing zone at base of Laramie.

The Laramie is, near its base, in the region now reported on, a persistent lignite- or coal-bearing formation. A few miles north of the 49th parallel, on the St. Mary River, a coal bed of excellent quality, eighteen inches in thickness, overlain by a bed holding *Corbicula occidentalis* and *Ostrea* occurs. It is described in my report on the Geology and Resources of the 49th Parallel (pp. 132, 172). Another coal outcrop, possibly of the same seam, and about a foot in thickness, is found on the Upper Belly River. The seam at the Indian farm near Pincher Creek, is probably again not far from the same horizon, though perhaps a little higher in the series. Coaly streaks occur in the sandstones at the disturbed locality on the Old Man River, which has already been referred to, and a lignite at Scabby Butte holds about the same position. Further north, the seam on the Bow at Coal Creek, between Morley and Calgary, and those in the vicinity of the Blackfoot Crossing, appear to occupy nearly the same stage. The thin seams near the mouth of the Highwood River may possibly be higher in the Laramie, and from the character of the St. Mary River subdivision throughout, it is not improbable that other coal- or lignite-bearing zones may occur locally. The character and surroundings of the more important seams now known are detailed on a subsequent page.

Fox Hill sandstones.

The Fox Hill beds, or their representatives in this district, appear to pass into the base of the Laramie upward, and below to blend with the Pierre, both lithologically and in their fauna. On the lower part of the St. Mary River, a massive sandstone, about fifty feet in thickness, which from its position at the top of the Pierre may be supposed to represent the Fox Hill subdivision, is well exposed. On the Milk River, near the crossing of the Benton Trail, and again north of the Buttes, yellowish sandstones occasionally holding marine shells (*Nucula cancellata, Liopistha undata*, &c.,) occur, and occupy the same position with regard to the Pierre shales. (See Plate I.)

Pierre shales.

The Pierre rocks, throughout this district, are not so homogeneous in character as further east, and frequently hold sandstone intercalations. The occurrence of the Pierre at the base of the West Butte has been described in my Report on the Geology and Resources of the 49th Parallel, already referred to. A further examination of this locality has since resulted in the discovery of additional fossils.

Distribution and character.

The Pierre is again seen with its characteristic fossils on the lower St. Mary River, and it has during the past summer been traced southward across the Milk River Ridge and Milk River to the 49th parallel. North-eastward it occupies a wide belt of country, owing to its low angle of outcrop, running on to the Bow River, a distance of eighty miles, and thence to the Red Deer River, a further distance of forty miles. On the Old Man River the upper part of the Pierre, for a thickness of about fifty feet, ceases to show its usual blackish or dark grey colour, becoming a sombre brown clay shale. On the Bow River the same appearance is found, but the beds so affected are several hundred feet in thickness, and there is also here toward the base of the Pierre a zone characterized by pale sandy clays and sandstone. A similar change, but even more pronounced, is found on the Red Deer River. The Pierre is, however, as a whole, the best marked and most easily recognized formation of the district. The most persistent coal-bearing horizon is included in its base, and has already been utilized in supplying Fort MacLeod, and for shipment to Benton on the Missouri by waggons returning from Fort MacLeod. A second coal seam occurs at the summit of the Pierre on Bow River, at Horse-shoe Bend. Details of these are given on a subsequent page.

Coal seams.

Sub-Pierre beds.

On both the Bow and Belly Rivers, and elsewhere, a series of pale, generally greyish and arenaceous beds at least two hundred feet in thickness are found underlying the Pierre shales. These have been designated as the Belly River series. On the Belly, a few large Unios and fragments of dinosaurian bones only were found in these Sub-Pierre rocks. Mr. McConnell has since, however, on Milk River Ridge not far below the Pierre shales, found, besides the unio above mentioned, several truly marine forms. On the lower parts of the Bow and Belly and on the S. Saskatchewan below their confluence, a series of beds containing estuarine fossils of Laramie (Judith River) type occurs. A more detailed account of this series is, however, reserved till some points as to the stratigraphy and fauna can be further investigated. In this series a seam of lignite, of good quality, but generally of small thickness, occurs on both the Bow and Belly Rivers. It is referred to again where, at one point on the Belly River, it becomes of possible economic importance. There is reason to believe that this seam is nearly on the same horizon with that of Medicine Hat, on the South Saskatchewan.

Beds on Lower Bow and Belly.

Equivalency.

The pale beds underlying the Pierre in this region represent, with little doubt, the Dunvegan sandstones of the Peace River section. (Report of Progress, 1879–80.) They are also evidently identical with those described by Prof. Cope as occupying a similar position on the Missouri (Bulletin U. S. Geol. and Geog. Survey, Vol. III., p. 568). This subdivision, which appears most probably to hold the position of the Niobrara in the Nebraska section, is therefore one of great persistence in the Cretaceous.

NOTES ON THE MORE IMPORTANT COAL SEAMS OF THE BOW AND BELLY RIVER DISTRICT.

Character of coals.

The fuels contained in the rocks described in the foregoing general notice, vary from lignites but slightly superior in quality to those of the Souris region, to materials containing a very small percentage of water, forming a strong coke on heating, yielding abundance of highly luminous hydrocarbons, and precisely resembling ordinary bituminous coals, though of Cretaceous and Laramie age. In describing them the term *coal* will generally be used, as it is impossible to draw a definite line between the two classes among the numerous intermediate varieties.

Seams on lower Bow and Belly.

The coal seam last referred to as occurring on the lower Bow and Belly Rivers, is seen in the banks for many miles at a height above the water, which varies in correspondence with the the light undulating dips by which it is affected. It is generally not more than a foot or eighteen inches in thickness though so persistent in extent, but at one point on the Belly River it thickens to three feet, forming a workable seam, which appears to be of good quality throughout. This locality is thirty-two miles in a direct line from "Coal Banks." No analysis has yet been made of this fuel.

Coal at Medicine Hat.

As above stated, the coal near Medicine Hat on the South Saskatchewan, is supposed to occupy nearly the same position in the series as that just referred to, and though Medicine Hat is beyond the limit of the district described in this report, a short note on that locality may be of interest. It was examined by Mr. McConnell last autumn while on his way down the river.

Exposures of the seam were found to occur on nearly every bend of the river from a point about thirty miles below the junction of the Bow and Belly to Medicine Hat. The seam is, however, more variable in thickness and character than many in this part of the North-west, and at two places on the river scarcely a mile apart, changed from two feet in thickness of shaly impure lignite to six feet thick of very fair coal.

An exposure twelve and three-quarter miles above Medicine Hat gave the following section :—

	ft.	in.
Yellowish sandstone	10	0
Coal (fair quality, 100 feet above water level)	4	6
Shales	1	3
Sandstone	1	0
Coal (fair quality)	4	0
Shales	6	0

Higher up in the same section another seam about four feet thick was seen.

Three miles above Medicine Hat, the seam is again well shown in the side of the river valley at a height of eighty feet above the water level, and with a thickness of four feet. No analysis of this fuel has yet been made, but in physical characters it is to some extent intermediate between the Souris coals and those of the Bow and Belly Rivers.

"Coal Banks," Belly River.

The locality just referred to as "Coal Banks" is at the crossing of the Belly River by the trail to Benton. The coal occurring at this place is that which has been described as existing at the base of the subdivision of the Cretaceous known as the Pierre shales. It is one of the best in the district, and has been worked to a small extent for some years at this point by Mr. N. Sheran. The outcrop of this seam is now known to extend southward to a point on the St. Mary River six miles from Coal Banks, and thence south-eastward about twenty miles, where it reappears on the Milk River Ridge. North-easterly, it runs to the Bow River about sixty miles, and thence to the Red Deer, forty-five miles further, giving a total length of outcrop, proved at a number of points, of about one hundred and thirty miles.

General character of valley and sections.

The drift deposits average about one hundred feet in thickness in the region near Coal Banks, and it is consequently, in general, only in the river valley or in the larger coulées which flow into it that the Cretaceous rocks can be seen. The Belly Valley in this part of its course is about 300 feet deep, and averages nearly a mile in width. It therefore cuts about 200 feet into the Cretaceous rocks, and displays fine sections of these. There are in this vicinity several associated coal seams, of which one is workable and has been opened by Mr. Sheran. I may, for the sake of clearness, refer to it as the "main seam." It is more or less perfectly exposed at intervals along this part of the Belly for a distance of about twelve miles, or from the workings at Coal Banks to Big Island of the map. Above Coal Banks the measures are affected by a light anticlinal swell which brings up older rocks, and the outcrop runs round to the west, appearing on the river again at the mouth of the St. Mary. At the furthest point up the St. Mary at which the coal appears (about seven miles from the mouth of the river), it occurs in the following section, the second column being a continuation of the first, but at a spot about one hundred yards further down stream:—

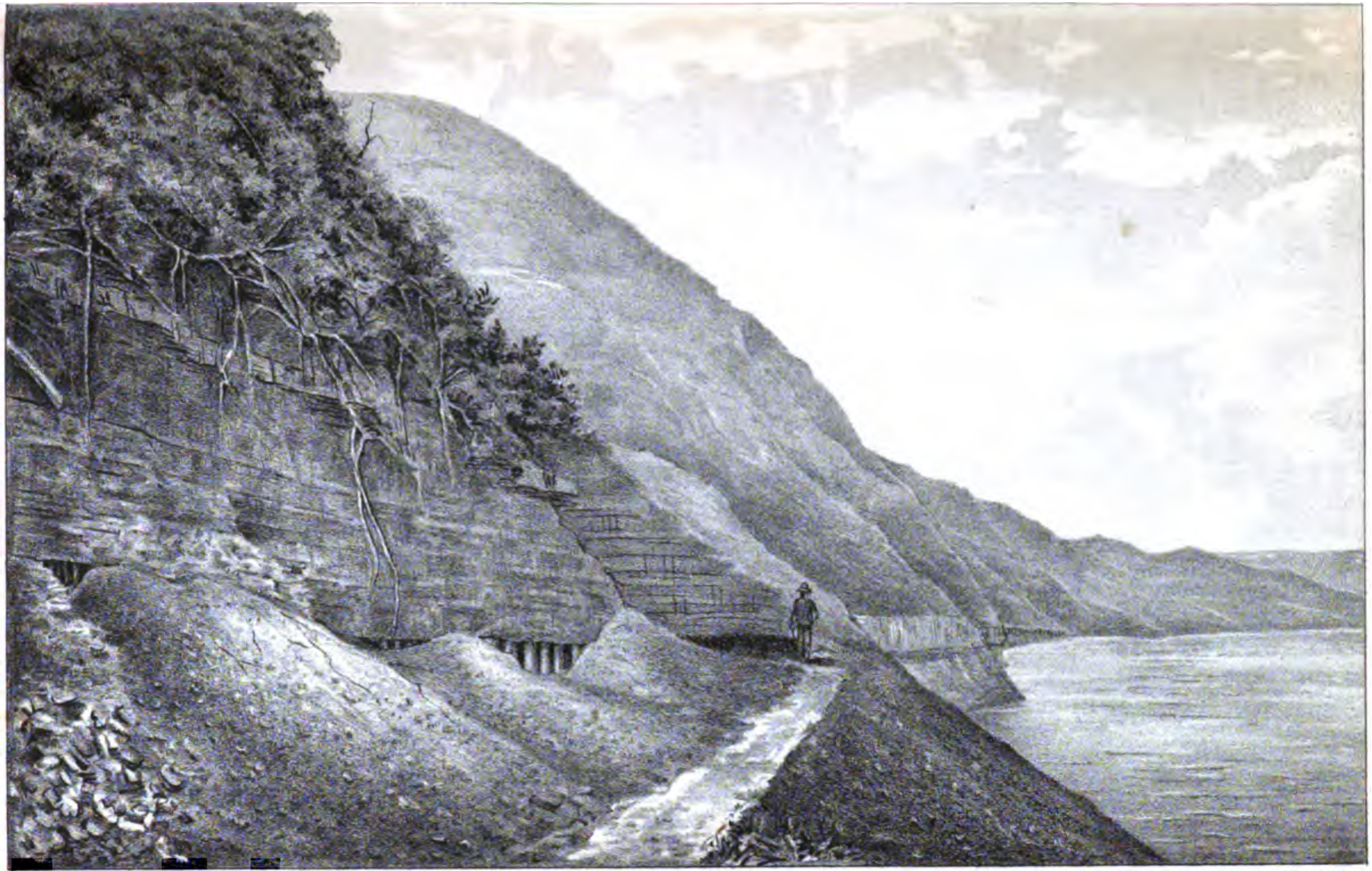
Sections on St. Mary River.

	ft.	in.
Rusty ironstone layer	0	8
Blackish and rusty shale	5	0
Coal	0	3
Blackish shale	6	0
Coal	0	6
Soft carbonaceous shale	0	4
Coal	0	8
Soft, thin shale, highly carbonaceous in upper part	0	6
Ironstone shale	0	6
Blackish shale	3	0
Coal	0	8
Carbonaceous shale (some coal)	1	6
Coal (partly below water)	1	6

	ft.	in.
Coal	1	0
Shaly coal	0	6
Coal	1	3
Shale	0	2
Coal	0	9
Grey shale	4	0
Coal	1	4
Grey Shale (to water)	4	0

About two miles further down the St. Mary the coals are again seen, with the following development:—

Coal (rather shaly)	1	0
Coal	1	4
Shale	0	3
Coal	0	9
Shale	10	1
Coal	3	8
Shale (with obscure plant impressions)	6	0



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OUTCROP OF MAIN COAL SEAM, COAL BANKS, BELLY RIVER.

At the mouth of the St. Mary the main seam has a thickness of three feet six inches, but about eighteen inches at the top is rather shaly.

Coal at Milk River Ridge.

Where seen on Milk River Ridge the seam is only fifteen inches thick.

On comparing the sections on the St. Mary with those at Coal Banks and on the Belly River to the north, it will be noticed that the coal at the first-mentioned locality is more divided by shales and less favourably situated for working.

Position of coal at "Coal Banks."

On the part of the Belly River near Coal Banks, the measures have as a whole a light westerly dip, while that part of the outcrop between Coal Banks and Big Island forms a minor synclinal depression in its edge, across which the river cuts in a direction nearly coinciding with the main strike of the measures, and gives rise to a great display of coal on this part of the valley. The coal-bearing horizon, as above mentioned, lies at the base of the Pierre, and its position between the dark shales of this formation and the pale sandy beds of that underlying it, renders it easy to define the situation of the coals, even where their actual outcrop is concealed. For a distance of five miles north of the Coal Banks exposures, the dark shales just referred to occupy the river valley, while the outcrop of the coal is carried eastward to an uncertain distance by the light synclinal undulation above referred to. The gentle inclination of the measures shows that the coal might be reached at a moderate depth by shafts sunk through the dark shales in this part of the valley, from which it might with facility be worked up its slope to the eastward. The undulating character of the dips renders it impossible, however, to estimate the exact depth at which the seam would be found, though it is probably not over 500 feet below the river, midway between its southern and northern outcrops in the valley. It may also be worked on a smaller scale, but with great facility, by levels driven into the actual outcrops in the river banks.

Having thus briefly described the general mode of occurrence of the coal on this part of the Belly River, the following more detailed notes on the outcrops which occur will serve to show the actual character of the seam.

Details of outcrops near "Coal Banks."

At Coal Banks, the coal has been extracted chiefly by quarrying along the natural outcrop, though during the summer of 1881 a small level was opened. The outcrop is situated in the front of a steep scarped bank facing the river, and the seam, which at the southern end of the bank is about 30 feet above the water, dips away below the water at the northern. (See Plate II.) The following section shows the mode of occurrence and association of the coal in the bank, but does not extend upward to the base of the drift deposits :—

Section at Sheran's.

		ft.	in.	
	Finely laminated grey shale	8	0	
	Coal (shaly below)	1	6	
	Grey, thin-bedded shale	12	0	
	Ironstone	0	3	
	Grey shale	1	9	
	Coal	0	8	
	Grey shale and nodular sandstone, carbonaceous below	7	0	
Main seam.	*Coal*	1	4	Coal. 5′ 4″
	Shaly parting (often almost absent)	0	4	
	Coal	4	0	
	Carbonaceous shale	2	0	
	Grey shale	2	0	
	Ironstone	0	4	
	Greyish and brownish shale	3	0	
	Carbonaceous shale	3	0	
	Coaly shale	0	8	
	Grey shale	2	0	
	Coal	0	4	
	Carbonaceous shale (to water)	1	4	

The dip at this place is about N. 83° W. (mag. variation 22° 46″ E.), at an angle of five to eight degrees.

On the opposite side of the river, at its next bend, the coal is again well shown. It is slightly undulating, and dips gradually away below the water level at the northern end of the bank. The part of the section designated above as the main seam is here as follows:—

	ft.	in.
Coal	1	6
Shaly parting (1 to 3 inches)	0	2
Coal	3	3
Total coal	4	9

About four inches in thickness at the base of the seam is here laminated in texture, but appears nevertheless to to be of good quality. The general dip is about N. 50° W. (mag.), at an angle of less than 5°.

Concealed interval. Section S. of Big Island.

From this point for a distance of five miles down the valley, the dark shales overlying the coal are alone seen. When it again appears, on the west bank of the river, the main seam shows the following section:—

	ft.	in.
Coal	1	6
Shale	0	3
Coal	4	6
Shale	1	6
Coal	2	9
Total coal	8	9

The lowest division of the seam at this place is apparently not represented in the sections previously described. The coal in it is somewhat laminated, but seems to be of good quality. The dip is here about S. 70° W. (mag.), at an angle of 5°.

About three miles further north, extensive exposures of the coal are again found in the scarped bank or cliff facing the river, at a height of about 100 feet above the water level. The dip is light and undulating, but on the whole westward, or away from the river. The main seam is here composed as follows:—

	ft.	in.
Coal	2	6
Carbonaceous shale	0	7
Coal	2	2
Carbonaceous shale	1	0
Coal	1	3
Total coal	5	11

The coal here appears to be of good quality throughout. North of this point on the river the main seam is not again found well exposed, though in several places the associated rocks are shown in such a way as to indicate that it outcrops below the drift deposits a short distance east of the river valley.

Coal on Little Bow River.

At the point at which the base of the Pierre should cross the Little Bow River, a seam of coal a few inches thick was observed by Mr. McConnell, but the exposures did not bring the main seam into view.

Continuation of seam on Bow River. Grassy Island.

This coal-bearing horizon appears again on the Bow River, opposite a considerable island, which I have named Grassy Island, about thirty-three miles in a direct line below the Blackfoot Crossing, in lat. 50° 25′ 15.″ In their general appearance, arrangement and thickness, the seams here exposed closely correspond with those on the Belly River. The subjoined section exhibits the relations of the coal at this place:—

	ft.	in.
Lead grey shale	25	0
Coal	1	6
Soft grey and yellowish-grey shaly sandstone	13	0
Carbonaceous shale, coaly streaks	2	3
Coal (good and sound throughout)	4	6
Dark grey shale and shaly clay	7	0
Coal	1	0
Carbonaceous shale	1	0
Coal	0	8
Soft shale and clay	8	0
Coal and carbonaceous shale (to water)	1	6

The beds dip westward at a very light and constant angle. The seam 4 feet 6 inches in thickness probably represents the main seam of the Belly River.

Composition of coal from this seam.

Some general facts regarding the composition of the coal of this horizon in the Cretaceous may be given. The analysis by Prof. Haanel quoted in my report on the Geology and Resources of the 49th Parallel (p. 179, No. III, in table) is of coal from this seam, but probably from that part of the outcrop near the mouth of the St. Mary River. The same remark applies to a specimen which was analyzed by Dr. Harrington. (Report of Progress, 1877-78, p. 49 C.) Prof. Haanel's analysis shows 6·69 per cent. of moisture and 6·31 per cent. ash. A specimen from Mr. Sheran's mine, collected and examined by myself, yielded the following result:—

Belly River outcrop.

Water	6·52
Volatile combustible matter	31·03
Fixed carbon	56·54
Ash	5.91
	100·00

The coal is compact, does not easily break up by handling or exposure, and is in every respect a very excellent fuel, though not yielding a coherent coke.

Bow River outcrop.

In correspondence with the increased distance from the mountains of the outcrop of the same seam on the Bow River, and the probable inferior degree of alteration to which it has been subjected, the coal is there found to contain more water, approximating in this respect to some of the Souris River lignites. From these, however, it still differs in its more compact texture and resistance to weathering and the regular vertical cleat or jointage planes by which it is traversed, which cause it to assume cuboidal instead of conchoidal forms on fracture. A preliminary examination of an outcrop specimen from this locality gave the following result:—

Water	12·37
Volatile combustible matter	32·33
Fixed carbon	46·39
Ash	8.91
	100.00

This seam, where it crosses the Red Deer River, has a thickness of about eighteen inches only.

Seam above Pierre shales.

The next recognized seam in ascending order is that at the top of the Pierre shales. As seen on the Bow River, at the point which I have designated as Horse-shoe Bend, it has a very light westerly or north-westerly dip, It is doubtless more local in character than the last, as it is not known on the Belly River, nor could Mr. McConnell find any corresponding seam on the Red Deer. The outcrop at Horse-shoe Bend is situated about fifteen miles east-north-east of the Blackfoot Crossing. The seam appears at a height of 135 feet above the water in a steep scarped bank on the south-east side of the river, and is exposed for nearly half a mile. It is 4 feet 4 inches in thickness, compact and hard where not long weathered, and in physical character resembles that last described. A preliminary examination of an outcrop specimen showed the following composition:—

Horse-shoe Bend.

Water	13·67
Volatile combustible matter	37·16
Fixed carbon	40.50
Ash (reddish)	8.67
	100·00

Still following an ascending order in the series, the seam which has been known for some years at Blackfoot Crossing next claims attention. This is several hundred feet higher in the section than the last, and is distinctly included in the Laramie. It is probable that still another seam exists between this and and that described, but no sufficient exposures of it were found.

Blackfoot Crossing coal seam.

Coal occurs in several places on the Bow River a few miles above the Blackfoot Crossing. The seams are too thin to work, but are probably on the same horizon with that described below. Throughout this region the beds are affected by gentle undulating dips, and though they have besides a very light general inclication westward, they may be considered as practically horizontal.

Outcrops above the Crossing.

The outcrop from which a small quantity of coal has been extracted, and which has been referred to by several travellers, is situated six and a half miles eastward from the Blackfoot Agency buildings, on a coulée which runs northward to the Bow. The deposit here consists of two seams, the upper averaging 1 foot 8 inches in thickness, the lower 3 feet. They are separated by about a foot of carbonaceous shale. At this spot the bed may be traced about 500 feet in natural exposures, and is affected by variable dips which do not exceed 5° in amount. The thickness of the seams continues nearly uniform, and they would afford, say, 4 feet 6 inches of clean coal, the whole of which could be worked at once. The immediate banks of the coulée are about 80 feet high at this place, the upper two-thirds being composed of drift deposits, which rest on a worn undulating surface of the rocks below. The general surface of the surrounding prairie at this place is about 110 feet

Outcrops on coulée E. of Crossing.

above the level of the coal, and no exposures of the coal or associated beds are found except in the river banks or coulées which cut deeply into the surface of the plain.

In following the coulée northward from the spot just described, the coal is frequently seen on the right or east bank for about a mile, after which the coulée opens into a wider valley with sloping grassy sides, and exposures cease. Owing to the slope of the bottom of the coulée toward the river, the beds are cut into more deeply near its mouth, and at the last exposure the seam is about thirty feet up in the bank. The upper seam is here not well shown, but the lower exhibits a few inches over four feet of good coal. In an exposure intermediate between this and the first, the upper seam is 8 inches thick, the shales 1 foot, and the lower seam 4 feet 4 inches. The seams are underlain by at least twenty feet of soft whitish sandstone. The same sandstone bed appears near the Agency buildings, where the Indian trail going eastward leaves the valley, but the coal seams here are wanting or very poor.

Outcrops on river E. of Crossing.

Between the Blackfoot Crossing and the coulée above described, the same coal-bearing horizon appears in several places in the banks of Bow River. The seams are here more favorably situated for working, and of greater thickness than in the coulée. The subjoined section shows their mode of occurrence at one point:—

	ft.	in.
Coal	1	8
Black carbonaceous shale	1	4
Coal	1	8
Shale	0	3
Coal	0	9
Shale	0	3
Coal	3	0
Shale	1	0
Coal	1	10
Total	11	10
Total coal	8	11

The coal is here underlaid by whitish sandstone for about 30 feet, or to the water's edge. Nearly opposite this exposure, on the south side of the river, the seam appears at intervals in the bank, at a height of about 40 feet above the water, for at least a quarter of a mile. It is affected by a series of light undulations.

Continuation on Crowfoot Creek.

At Crowfoot Creek, six miles north-east of the Blackfoot Crossing, a seam of coal eighteen inches thick appears, which is probably the highest in the group of beds above described, the section not showing the lower part of the series.

Economic importance.

The natural exposures serve to prove the continuity in good workable thickness of this coal deposit over a tract of country several miles in extent, and its nearly horizontal attitude and moderate depth below the surface of the plains, would enable it to be proved by boring at a small expense over any desired area.

Composition.

In texture, this coal is not so firm or well adapted for transport as those of the localities previously described, but its composition appears closely to resemble that of Horse-shoe Bend.

The following are analyses of the fuel from this place; the first from a specimen obtained by Prof. Macoun, the second from one collected by myself, and probably not subjected to such prolonged desiccation:—

	I*.	II.
Water	10·72	13·20
Volatile combustible matter	29·26	33.80
Fixed carbon	46·09	48·10
Ash	13·93	4·90
	100·00	100·00

Continuation of seam on Red Deer.

This seam is probably continuous to the Red Deer River, and the same with that which occurs at the mouth of the Arrow-wood River, with a thickness of six feet.

Coals nearer the mountains.

Four coal-bearing localities on the head waters of the Oldman River appear to be of sufficient importance to obtain notice at the present time, but as the country toward the base of the mountains becomes more fully known, it is probable that numerous additional outcrops will be discovered.

Seam at Indian Farm,

At the Government Indian Farm, south of Pincher Creek, a seam of coal occurs about one mile from the farm buildings, up the valley of the small stream on which they are situated. The rocks in the lower part of the valley belong to the St. Mary River subdivison of the Laramie, and dip toward the north-north-east (mag.) Their angle gradually increases from about 20° till the beds become nearly vertical where the coal occurs. Beyond this point the rocks are concealed, but the coal probably occupies a position very near the base of the Laramie.

Near the coal seam, the beds have been much disturbed, and the coal itself is slickensided and broken throughout in such a way as to cause it to crumble easily by handling. The seam is two feet in thickness where exposed, but is said to have been considerably thicker where followed into the bank. The opening made on the coal had,

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[*] By Mr. C. Hoffmann. Report of Progress, 1879-80, p. 12 H.

however, fallen in before the time of my visit. The seam should reappear on Pincher Creek about a mile above the crossing place of the road, but the rocks at this place are not well exposed.

Analysis.

An analysis of the coal from this seam by Mr. Hoffmann is given in the Report of Progress for 1878-79, p. 12 H. It may be quoted here for comparison with those of the other seams, and illustrates the improvement in quality of the coals on their approach to the base of the mountains:—

Water	6·26
Volatile combustible matter	29·31
Fixed carbon	55·70
Ash	8·73
	100·00

Seams on Middle Fork of Old Man.

On the Middle Fork of the Old Man River, a few miles below the falls, and nearly north of the mill on Mill Creek, two seams of good coal occur in a scarped bank on the north side of the stream. The beds are each about three feet in thickness, and are folded in a very remarkable manner, illustrating the intensity of the force which has acted in crumpling the rocks near the base of the mountains. It is probable that these beds also occupy a horizon near the base of the Laramie. An analysis of the lower seam shows 56·38 per cent. of fixed carbon and 8·32 of ash.

The section in which these coal seams occur is as follows. The order appears to be descending, but the whole may not improbably be overturned:—

	ft.	in.
Grey to black, very fine shale, with occasional small fish scales and bones, becoming sandy and yellowish at base.	6	0
Ferruginous sandstone	0	6
Greyish soft sandstone or arenaceous clay, with some thin ironstone layers	10	0
Harder greyish and ferruginous sandstone, with some obscure plant fragments	6	0
Hard, flaggy, yellowish sandstone	2	0
Grey sandy shale and shaly sandstone	3	0
Coal	3	0
Soft black carbonaceous shale	0	9
Grey sandy shale	3	6
Grey sandy shale and sandstone	4	6
Grey flaggy sandstone, weathering rusty	2	6
Grey sandy shale and shaly sandstone	5	0
Coal. (Imperfectly seen, but at least 3 feet of good quality)	3	6
Carbonaceous shale	1	0
Grey sandy shale	4	0

	ft.	in.
Ferruginous sandstone	0	6
Greenish-grey sandstone	10	0
Grey and blackish carbonaceous shale	4	0
Greenish-grey, soft sandstone	6	0
Sandstone and arenaceous and carbonaceous shale, with general greenish-grey tints, (about)	80	0
	155	9

Seam on Mill Creek.

On Mill Creek, about four miles above the mill, a seam of coal outcrops. The measures are somewhat broken, and the seam appears to be rather inconstant in thickness. It is not improbable that it may yet be traced southward and northward and found to outcrop on other streams which cross the measures nearly parallel to Mill Creek. The coal is of excellent quality, containing 63·39 per cent. of fixed carbon, with 12·37 of ash. It has been used to a small extent for blacksmith's work at the mill. The following are sections of the seam on opposite sides of a break or fault which traverses the measures at the outcrop:—

	ft.	in.
Coal (rather shaly)	3	1
Coal	2	0
Shale	1	4
Coal	2	0
Shale	1	4
Coal	2	0
Total coal	9	1

	ft.	in.
Coal (rather shaly)	2	0
Shale	1	0
Coal (apparently good throughout, with the exception of a few shaly partings, not equalling 4 inches in all)	6	0
Total coal	8	0

The geological horizon of the coal at Mill Creek has not been determined.

Seam on North Fork of Old Man.

Lying also close to the foot of the mountains, about a mile and a half from the first limestone range on the North Fork of the Old Man, is a seam of coal about five feet thick, dipping westward at an angle of thirty-five degrees.

Seam on Coal Creek, Bow River.

At the mouth of a stream which enters the Bow River from the north, between Calgarry and Morley, three miles and a half above the Jumping Pound River, I examined a seam of good coal which had a thickness in the natural exposure of about a foot.

At a point further up Coal Creek, the seam has since been worked to a small extent. Mr. McConnell visited this locality, and reports about three feet of good coal, with several feet of carbonaceous shales. The seam is evidently very variable, and becomes quite thin at a short distance from the spot just alluded to, along the strike.

General Remarks on the Coals and Lignites.

Great extent of coals.

Whether from an economic or purely scientific point of view, one of the most interesting results of the exploration of the Bow and Belly River country, is the determination of the fact that the coals are not confined to a single horizon or formation, but characterize several zones in the geological series of this region. The fuels found in the Laramie represent, at least in a general way, those known to occur in the same formation or its representative, the Fort Union Group, eastward on the plains to the Souris River. As far north as the Athabasca and Peace Rivers, fuels are now known to characterize the rocks of about the same age. The coal seam which has been referred to as attached to the summit of the Pierre shales, is not known to be represented elsewhere, unless indeed by a very thin seam near the same horizon on the Smoky River. (Report of Progress, 1879-80, p. 125 B.)

Relations with other known seams.

The coal at the base of the Pierre shales which has been worked at Coal Banks, on the Belly River, has not been recognized in a workable form beyond the limits of the district now described. The dark, highly carbonaceous beds at the base of the Upper Shales of Smoky River, are, however, at about this stage, and in one place a thin seam of lignite coal is locally developed (op. cit. p. 118 B.) A bed of lignite coal described by Prof. Cope on the Missouri as in some places of possible economic value must also be of nearly the same age. (Bulletin U. S. Geol. & Geog. Survey, Vol. III., p. 566.) It is further worthy of remark that this coal-bearing horizon at the base of the Pierre of the interior continental region is, as nearly as possible, equivalent to that at the base of the Chico Group, which yields the coals of Vancouver Island at Nanaimo and Comox.

An abundant supply of fuel.

The occurrence of workable coal seams at several different stages, and the proved continuity of some of them over great areas, guarantees an abundant supply of fuel in this district, a matter of great importance in a country which over extensive tracts is almost entirely destitute of wood. The quality of some of the fuels is such as to render them suitable for transport to a distance, and it is doubtless on this belt of coal-bearing rocks in the vicinity of the mountains that the railways of the North-west will chiefly depend for their supply.

As a good deal of misapprehension has arisen as to the character and

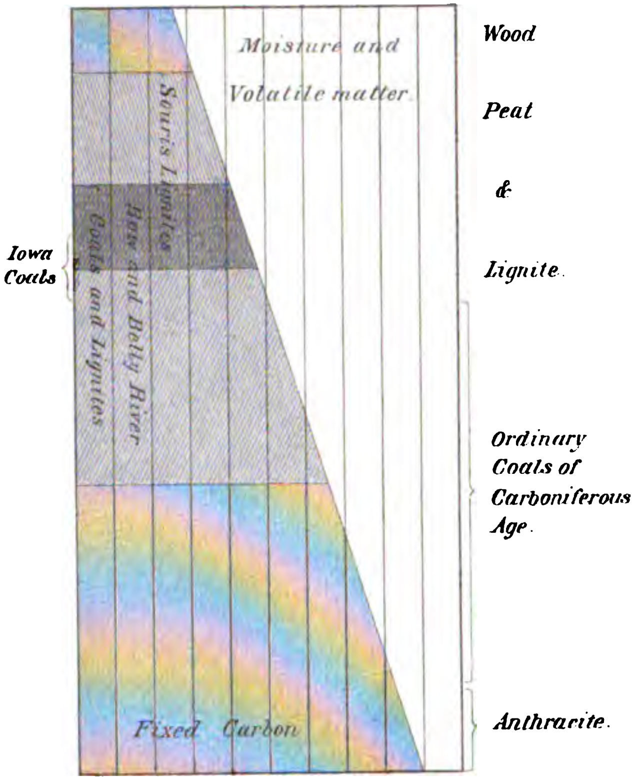

DIAGRAM ILLUSTRATING RELATIVE COMPOSITION OF COALS, LIGNITES, ETC.

value of the lignites and coals of the North-west, the annexed diagram has been constructed for the purpose of illustrating, in a general way, their place in the scale of fuels. The fuels are here classed according to the amount of "fixed carbon," (charcoal or coke) which they yield. This method of classification, though by no means complete as regards the heat-giving capacity of a fuel,—as much also depends on the quantity of moisture and ash, and quantity and nature of the volatile combustible matter—yet approximates sufficiently to the truth to illustrate the heating value in a broad general way. The shaded portion of the diagam represents the fixed carbon graduating from twenty-five per cent. (charcoal) in wood to over ninety per cent. in anthracite, the complement to 100 per cent. being in each case made up by moisture and volatile matter. The spaces between the vertical lines represent ten per cent each. An inspection of the diagram will show how favourable a position the workable coals and lignite coals of the Bow and Belly River region hold, and how completely they bridge over the gap which is sometimes assumed to exist between coals and lignites. The fuels near which the lower line is drawn in the diagram for the Bow and Belly region, are those which are found in the disturbed belt near the base of the mountains, and, as before explained, appear to have been affected to a certain extent by pressure and possibly by heat, developed in connection with the folding of the beds. The upper line for the Bow and Belly coals, it will be observed, overlaps the lower line drawn for the lignites of the Souris district, showing that in regard to content of fixed carbon the better class of Souris fuels are about equivalent to the lower grades of those of the Bow and Belly. The brace on the left of the diagram indicates the range,—as regards the proportion between fixed carbon and volatile matter—of the carboniferous coals of Iowa. These are interesting not only on account of the greater quantity of moisture and volatile matter, which many of them hold as compared with ordinary carboniferous coals, but from the fact that they are likely to enter into direct competition with the fuels of the western region here reported on, in the Manitoba market.

Coals and lignites not distinctly separable.

Explanation of diagram.

The coals of the Bow and Belly district are, in fact, similar to the class of fuels now largely mined and employed on the western part of the line of the Union Pacific Railway, and much superior to most of the lignites and brown coals which give rise to important industries in various parts of Europe. The chief difficulty to be apprehended in connection with the extensive use of the lignites of the Souris River region is the fact that they yield so readily to the weather on exposure, and become more or less pulverulent, leading to a great waste during handling and transport. The writer has during the past summer had an opportunity of studying the methods of mining and overcoming

Comparison with other American and European fuels.

Modes of employing lignites and brown coals.

similar difficulties to that just referred to in several districts in Germany and Bohemia, which depend on lignites and brown coals for their fuel supply. The brown-coal of the Saatz-Teplitz basin in Bohemia, from which over a million tons were extracted in 1879, closely resembles in composition and even in physical character those of the Souris district. The thickness of the bed is there, however, so great, and the price of the fuel in consequence so low, that though much is lost from crumbling, no economic process to prevent this waste has yet been found applicable. The fuel, however, answers well for domestic and local manufacturing purposes, and is even employed in locomotives and transported to a considerable distance in the raw state. Brown coals, much inferior in composition and strength, worked in South Germany, are also used as they come from the mine for some industrial purposes, specially constructed furnaces being employed. For transport, however, they are generally compressed by steam machinery, either in the wet or dried state, into masses known as "briquettes," and thus treated constitute a very valuable fuel.

Processes of this nature will probably eventually be found applicable to the Souris lignites, rendering them of greater value, and suiting them for carriage to any distance. The coals and lignite-coals of the district specially referred to in this report are, however, for the most part independent of such aids, even for purposes of distant transport; and though their greater distance from the province of Manitoba must increase the cost of their delivery there, their character will probably be found to more than compensate for this disadvantage.

Estimated quantity of coal per square mile.

The quantity of coal already proved to exist is very great. The distances for which the outcrops of certain seams have been traced have been mentioned. Approximate estimates of the quantity of coal underlying a square mile of country in several localities have been made with the following results:—

Main Seam, in vicinity of Coal Banks, Belly River. Coal underlying one square mile, 5,500,000 tons.

Grassy Island, Bow River. (Continuation of Belly Biver Main Seam.) Coal underlying one square mile, over 5,000.000 tons.

Horse-shoe Bend, Bow River. Coal underlying one square mile, 4,900,000 tons.

Blackfoot Crossing. Workable coal in seam as exposed on Bow River. Underlying one square mile, 9,000,000 tons.

Note on Map.—The annexed map shows the positions of the chief natural exposures of coal and lignite in the Bow and Belly district, and the probable course of the outcrops of such of the seams as it has been possible to identify at a number of places. The edge of the Palæozoic rocks of the mountains, constituting the western border of the coal-bearing district, is marked by the red shading, but no attempt is made to indicate the general geology of the region, which will appear in connection with the detailed report on the district, now in course of preparation. The main outlines of the present map are based on the surveys of the Dominion Lands department wherever possible, but much of the topography and detail are from our own surveys.

GEOLOGICAL SURVEY OF CANADA.

ALFRED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR.

REPORTS

BY ROBERT BELL, LL.D., M.D., C.E.

ON THE GEOLOGY OF THE

BASIN OF MOOSE RIVER

AND OF THE

LAKE OF THE WOODS

AND ADJACENT COUNTRY.

1881.

PUBLISHED BY AUTHORITY OF PARLIAMENT.

Montreal:
DAWSON BROTHERS.
1883.

ED R. C. SELWYN, ESQ., LL.D., F.R.S., &c.,
Director of the Geological and Natural History Survey.

Herewith I have the honor to submit a report and map in regard
e geology of the Basin of Moose River and adjacent regions, and
a report and geological map in reference to the Lake of the Woods
he country lying to the eastward of it, in both of which districts
s engaged in pursuance of your instructions, in 1881. The maps,
ver, serve to illustrate, not only the field-work of this particular
n, but also the results of the labours of some of the previous years
e areas which they cover, and which were described in the annual
rts of the survey. A map of the Moose River, from the neighbour-
of Moose Factory to James' Bay, from a survey made by myself
77, is also herewith submitted.

I have the honor to be,
Sir,
Your obedient servant,
ROBERT BELL.

tawa, May, 1883.

I.

REPORT

ON THE GEOLOGY OF THE

3ASIN OF MOOSE RIVER

AND ADJACENT COUNTRY,

BY

ROBERT BELL, LL.D., M.D., C.E.

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tly after my return from making the geological examinations regions above indicated, a preliminary report was submitted and d to in your summary report to the Minister of the Interior in ry, 1882, pages 6 and 7. This work could not be fully described roper maps of the surveys had been prepared, representing both ography and geology of the regions indicated. The accompany- p of the basin of Moose River and the adjacent country shows, y the results of the surveys and geological investigations made writer and his assistant in 1881, but also part of those made in 875, 1876 and 1877, together with the results of a geological tion of the upper Ottawa and Lake Abittibi region, made by the alter McOuat, of the Geological Survey, in 1872. These investi- are described in the Reports of the years indicated. The coast- Lake Superior is from Bayfield's chart. The topography of the is principally the result of the work of the Geological Survey, portion of it is derived from surveys made for the Canadian Railway; and I would here beg to acknowledge our obligations srs. Smellie, Ramsey, Carry and Poulin, engineers of this line, rmation and maps relating to these surveys.

Geological map of the region.

Results of labors of 1870-75-76-77 and 1881.

object of the explorations in this region in 1881, was to ascertain, ly as possible, the distribution of the formations in the country northward and eastward of the mouth of the Michipicoten River, it was more imperfectly known than in other parts of the area nted upon the map. The present report will refer more particu-

Map represents an area larger than England.

larly to the geology of this district. The country represented o map is 344 miles in length from east to west, and 224 miles in bre from north to south, and embraces an area greater than that of Eng

Age and distribution of the rocks.

The distribution of the rock-formations, as shewn on this map, is provisional, but it is considered worth publishing the map to sho present state of our knowledge both of the topography and the geo of this great region, and also that it may serve as a basis to be impr upon in the future. In some parts, both the topographical and the logical lines will be found tolerably accurate, while it is believed none of the geographical features marked in continuous lines are far out of position. The junctions of the formations were corr ascertained along the rivers and lakes surveyed or explored. I case of the boundaries between the Laurentian and Huronian rock these formations appear to be conformable to each other in this re the course of the lines dividing them could often be inferred, with degree of accuracy, by the prevailing strike of the two sets of throughout a great thickness of the strata on either side of the obs contacts.

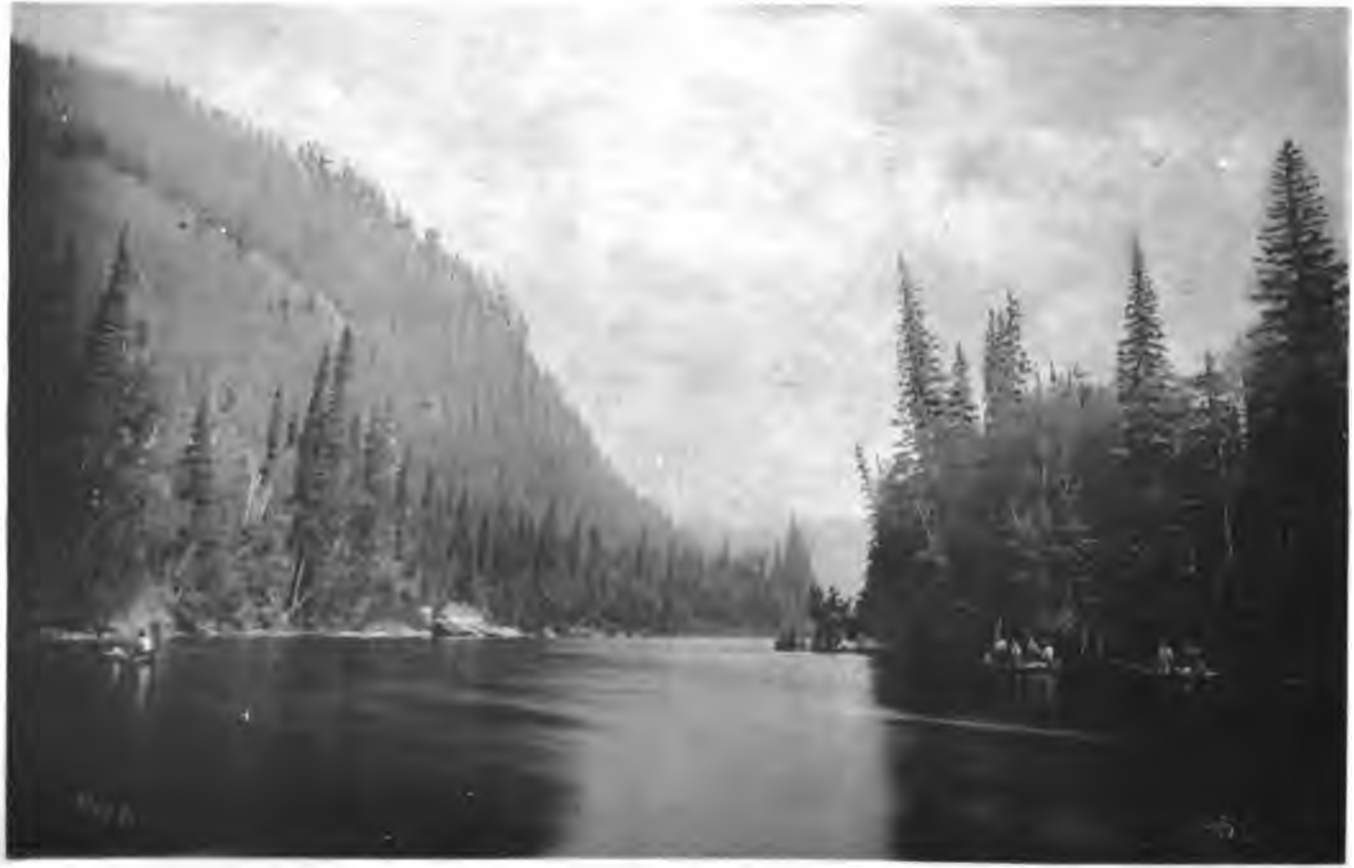
It will be noticed that a large part of the country represente the map is occupied by Huronian rocks, which are generally ri economic minerals. The prospect for the discoveries of metallic is increased in some districts by disturbances, and by the freq intrusion of diorites, syenites and granites. This is especially the in the region extending from the sources of the Montreal River east to the Abittibi Lake.

The present map will no doubt prove useful in many ways, now the Canadian Pacific Railway is about to be built through the s western part of the territory represented and other railways are jected to traverse various parts of it.

The work of 1881.

A short account will now be given of the investigations ma 1881, in the region under consideration. Having, in 1875, mappe canoe-route between Lake Superior and Moose Factory, by way o Michipicoten and Missinaibi Lake and River, this was used as a bas the operations of the present season. At Lake Mattawagaming, the from Lake Superior, a leading canoe-route diverges to the northw and this was adopted as a means of obtaining access to the count that direction. In connection with the geological investigation o region, a track-survey, checked by numerous latitudes, was mac the north-west arm of Lake Mattawagaming, Lake Wabatongwasl Oba Lake and River, Kabinikagami Lake and the river of the name to latitude 49° 35′.

At the same time Mr. C. Molson, B.A., Assistant Geologist, ma similar survey of Esnagami Lake at the head of the Magpie Riv



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GRANITE HILL ON MICHIPICOTEN RIVER, FOUR MILES ABOVE LONG PORTAGE.

part of this river and of a canoe-route thence to Oba Lake, and also some further geological researches around Lake Mattawagaming.

The following is a brief statement of the geological results of the investigations in the basin of Moose River and the adjacent country, including the Michipicoten and Magpie Rivers. The canoe-route from Michipicoten Post to Moose Factory follows the Michipicoten River and the lakes on its course to Mattawagaming Lake, and thence through Dog Lake, just on the south side of the height of land, and separated from the last named lake by a narrow stream a few chains in length.

Geology of the vicinity of Michipicoten.

From Lake Mattawagaming another canoe-route branches to the northward and enters Lake Wabatongwashene, which may be regarded as the source of the Michipicoten River. As stated in my report for 1875, pages 335-336, Huronian schists, with diorites, syenites and granites prevail along the route between Dog Lake and the mouth of the Michipicoten River. Gneiss is there mentioned as occurring at the Cat Portage and the head of the Long Portage. These exposures appear to be at the junction of the Laurentian and Huronian systems, as indicated on the accompanying map. A variety of gneiss which may belong to the latter division was found at a southward bend of the river, about half-way from the mouth to the foot of the Long Portage. The strike was here south-westward. The dividing line between the Huronian area of Michipicoten and the Laurentian gneiss to the south-east of it, appears to have a north-eastward trend, from Cape Choyyé, on Lake Superior to Dog Lake, keeping mostly to the south-east of the Michipicoten River. It crosses Dog Lake, in a north-north-westerly course, and curving round, passes through the southern extremity of Wabatongwashene Lake, in a westerly direction, finally reaching the shore of Lake Superior in the neighborhood of Otter Head. It will be observed by the map that the granite and syenite areas along the Michipicoten River, referred to in 1875 (Report, page 335) and the granite of Burnt Point, mentioned in the Geol. Survey report for 1876, page 219, lie nearly in a straight line and close to the junction of the Huronian and Laurentian. This, as stated in former reports, is the usual position of these granite areas in the great region northward of Lakes Huron and Superior. The light-grey granite, which occurs about four miles above the Long Portage forms the steep hill, about 400 feet high, on the northern side of the river, represented in the accompanying illustration taken from a photograph.

Granite areas.

Geology of a route northward from Lake Mattawagaming.

The geological features of the Michipicoten River were noticed in the report for 1875, pages 334–336, and I shall now add a description of the rocks of the route by which we travelled northward from the outlet of Mattawagaming Lake, where we turned off from the route to Missinaibi Lake. The rock of Little Stony Portage at the outlet of the former lake consists of fine-grained, massive, soft, greenish-g calcareous schist, with large veins of white quartz, which are seen in river below the chute. Leaving this portage and going northward up western shore of the lake, a hill of red syenitic granite is met with distance of two miles; and a similar granite is more extensively de oped on the southern side of the lake directly opposite. With exception, the rocks all along this side of the lake to its nort extremity, consists of green hornblendic, dioritic and chloritic sch The strike varies much, being north-eastward in the southern part north of west in the northern. Opposite Waboose Island, the hornbl schist contains pebbles, and at a point three miles further north, a greyish-green schist, with calcspar in the joints, is, in places, full of l concretions of impure epidote, some of which have a ring-like form cross section. Waboose Island consists of silicious green schist, run N. 35° W., vertical. Copper pyrites was found in a small quartz cutting green schists, at a spot on the west shore, lying south-west of north-west point of this island.

On the neck of land separating Lake Mattawagaming from I Wabatongwashene, the following rocks were met with in going f south to north in the order stated; bluish-grey, micaceous hornbl schist, coarse greyish-green hornblende schist, dark-grey crysta diorite (in one place rendered porphyritic by spots of light, greer yellow felspar), grey "pepper-and-salt" gneiss, composed of qu felspar, green hornblende and black mica, and lastly hornblende sch all followed to the northward by reddish gneiss. The general stri a little south of west.

Lakes Wabatongwashene and Oba.
Oba River.

Proceeding northward through Wabatongwashene and Oba La and down the Oba River, Laurentian gneiss was the only rock obse after leaving the Huronian schists in the southern part of the for lake, until meeting with the two narrow bands of schists which Kabinakagami Lake. These have a general west-south-westerly st and consist principally of hornblende schist.

At the inlet of the lake, much fine-grained magnetic iron is seminated through the hornblende rock, which also holds strings long lenticular patches of crystalline epidote, running with the st The larger patches are quartzose in their centres and are evidently cretionary. The hornblende schists of this belt are mostly compact dark greyish-green in color. In some parts they are micaceous, where they cross the southern part of the lake they are marked by stained patches, and are flanked on the north-west side by soft, very grained, grey gneiss, which has the calcareous character of the gne of the Huronian series, and contains specks of iron pyrites. Both are characterized by masses and bands, parallel to the stratificatio light-grey, felspathic granitoid rock.

Kabinakagami Lake and River

A small island, situated a few hundred yards south of the outlet of Kabinakagami Lake, consists of rather coarse, greyish gneiss, dipping north-east, cut by a dyke of crystalline, greyish-green diorite, fifty or sixty yards in width, running N. 20° E. and S. 20° W. The relation of the great north-and-south dykes of the region north of Lakes Superior and Huron to the topographical features, has been pointed out in former reports. It is probable that the dyke, just referred to, has had something to do with the position of the outlet, and the course of the lake immediately above it and of the river for some miles below. In connection with this subject, it may be mentioned that a similar diorite, apparently forming part of a great dyke running down the centre of Oba Lake, was discovered upon an island in the narrows, about midway between its extremities.

A fragment of dark-green serpentine, with rusty surfaces, was found on the small island near the outlet of Kabinakagami Lake. It resembles the serpentines of Lake Abittibi and Pigeon Lake, on the Montreal River.

A strong rapid, with a fall of thirty-three feet, occurs just where the Kabinakagami River leaves the lake. The portage past this obstruction is on the west side, and is 1145 paces in length. The rock at the rapid is a dark-green, fissile-hornblende schist, the strike of which varies from N. 45° W. to N. 80° W. At fourteen miles in a straight line below the lake, mica-schists, mostly coarse in texture and grey in color begin, and thence occupy a breadth of about one mile. They are vertical, and strike S. 80° W. Ten miles below this band, dark silicious mica schists make their appearance, and are found again three miles further down. These rocks, however, probably have a greater breadth to the southward than above indicated, since the strata for a number of miles before reaching the first exposure are concealed by a thick deposit of stratified sand. They may have a total breadth of seven or eight miles along the river. These two mica-schist bands appear to indicate the western extension of the great Huronian belt, which, coming from the eastward, crosses the Missinaibi between the Devil's Rapid and the junction of the Brunswick River, and which is largely made up of similar mica-schists.

Huronian bands.

An exposure of syenitic granite occurs at about a mile and a half below Kabinakagami Lake, and dark, greenish-grey crystalline diorite, apparently belonging to large dykes, was met with in several places as far as the river was descended. The point at which I turned back was found to be in latitude 49° 35′. With the exceptions above noted, the rocks found along this stream were entirely Laurentian gneiss, mostly of massive varieties. The stratification was usually much contorted, but the general strike was about east and west.

Although the Kabinakagami River appears to join the Missinaibi, as indicated on the accompanying map, some of the Indians we met v had an idea that it might join the Kenogami, a branch of the Alban the place called Mammattawa. (See Geol. Survey Report for page 113).

Mr. Molson, in his track-survey of Esnagami Lake, the upper pa the Magpie River, and the canoe-route thence back to Oba Lake, fo only Laurentian gneiss, which presented no characters worthy of spe description.

Exploration from Missinaibi House towards Flying Post.

Kapuskasing Lake and River; Trout River.

Rocks between Missinaibi and Trout Rivers.

Rocks of Trout Lake.

Schists.

Granite.

Amygdaloid Calcspar.

Apatite.

Fluorspar.

Having completed our labours in this direction, we proceede Missinaibi Lake, from which Mr. Molson was sent to make a tr survey of the Wi-a-sitch-a-wan River, which enters the south-east of this lake, and of Little Missinaibi Lake at its head; while I descer the Missinaibi River to Flying Post Brook, about eight miles from outlet; and leaving the river here, followed a canoe-route towards Flying Post, as far as Trout River. This stream flows from the so and joins the Kapuskasing River, just below the outlet of the lake of same name. It was followed for fifty-two miles in a straight line, its course, as well as the lakes through which it passes, were caref laid down. These topographical features are sufficiently well sh upon the accompanying map and do not require any special descript Between the Missinaibi and Trout River the rocks observed consi entirely of Laurentian gneiss, having an average strike of about S. W. It is mostly massive, but on Lake Tchi-tchi-ga-mog, eight m south of Kapuskasing Lake, much of it is of a grey, slaty, micace character. Along the Trout River, different varieties of gneiss w met with as far as Trout Lake. Along this stretch of the river direction of the dip and the angle of inclination changed frequen Trout lake is five miles in length, in a north-and-south direction. Gn was observed on the north-west side of the outlet, but on the east s silicious hornblendic schists appear to occupy the shore to a point h way up the lake. Here a variety of red and reddish-grey syenitic gran and of diorites are met with. Three miles south of the outlet, and mile north of the inlet of the lake, the reddish granite is cut by vein yellow-weathering pearl-spar, and it holds patches of grey amygda in which the spots, consisting of white calcspar, from mere grain the size of peas, are thickly disseminated. Along with the amygdaloi patches, there are others of white calcspar, and light green apatite, latter occurring in small thickly disseminated crystals in the calcs and as patches of a granular and very friable character associated v it. The amygdaloid also holds crystals and scattered masses of crys line bright green fluorspar.

Syenitic granites, similar to those just described, are met with on opposite side of the lake, and the mass to which they belong appear have a general east-and-west trend. Between the inlet and the head of Trout Lake, a distance of about a mile, the rocks on both sides consist of rather coarse, dark-coloured hornblendic schists, with a general westward strike, and a dip to the north of 60° to 70°.

The country around Trout Lake is hilly, especially to the south-westward. The river, in entering its eastern side, passes down a steep rapid, with a fall of 144 feet from the head of the portage, which is three quarters of a mile in length; it continues rapid for another mile, but beyond this it is very tortuous with a smooth, moderate current. The elevation of the highest point we reached was ascertained by means of the barometer to be 254 feet above Trout Lake. The rocks in this interval consist of Laurentian gneiss, having a general strike a little to the south of west, and dipping to the north in most cases.

Huronian rocks in the vicinity of Flying Post.

From information derived from Mr. A. R. Ramsey, and Mr. B. R. Poulin, engineers of the Pacific Railway, and also from Mr. E. B. Borron, stipendiary magistrate, it appears that Huronian schists prevail around Flying Post Lake and Lake Mattagama, lying to the south of it. During the season of 1881, Mr. Borron, who was sent by the government of the Province of Ontario, explored the country from Missinaibi House to the Flying Post, and thence to Mattagami Post to the east, which I had reached in 1875 from the Montreal River, a branch of the Ottawa. In the summer of 1882, the same gentleman explored a canoe-route by way of the Mississagui River, from the north shore of Lake Huron to the Flying Post and thence by the Kakozhishk, or Ground-hog River to its junction with the Mattagami. Mr. Borron has a good knowledge of mining and geology, and made valuable notes on the rocks he met with on his journeys. These have been of assistance in laying down the distribution of the formations in the region referred to. We are also indebted to Mr. Borron for a copy of his "log," containing the courses and estimated distances along some of the routes which he travelled.

On his last named journey he crossed the height of land, a short distance east of longitude 83° W. and struck Lake Wakamagaming at the source of the Ground-hog River. In descending this stream he saw no rocks excepting Laurentian gneiss until reaching Cache Lake, the centre of which is near latitude 47°. 40′, longitude 82.° 46′ W. "A schistose rock, Huronian, here forms the shore." From Cache Lake, the river runs a little north of east to a point within about nine miles of the southern extremity of Lake Mattagama, "following nearly, as it appeared to me, the strike of the Huronian rocks at or about their junction with the Laurentian. The river then, finding a passage, turns north, crossing the Huronian ridges, and at the end of nine miles tumbles into a large basin at the south end of Lake Mattagama." (Mr. Borron's Report for 1882, page 23.) At page 30, he says: "I met with lead and

Veins with copper and lead ores.

copper ores on the north-west side of the eastern arm of Lake Ma gama, in the vicinity of Flying Post. The quantity of ore in the ve where exposed is not such as would justify, in my opinion, expens mining operations, but sufficient, taken in connection with the size general character of the veins, to warrant careful exploration in reasonable expectation that larger deposits of these useful and valua metals may be discovered."

Wi-a-sitch-a-wan River.

Little Missinaibi Lake.

On my return to Missinaibi House, I found that Mr. Molson arrived there from his exploration a few days in advance of me. had ascertained the following facts: The upward course of the W sitch-a-wan River is S. S. E. for two and one half miles in a straight li when the outlet of Little Missinaibi Lake is reached. The river is brol by a succession of rapids and falls throughout the whole of its sh course. The main body of the lake, which is narrow, has a general sou eastward direction, and a length of about five miles. Two narrow b extend at right angles from the north-east and three from the south-w side. The southernmost bays, on opposite sides, have the same gene direction, and the distance between their extremities is over five mi A stream enters the head of each of them. The upward continuatio the main river is at the south-eastern extremity of the lake, and course is the same as that of its central part. It was followed for ab six miles, and here, leaving the river, Mr. Molson explored the count for five miles further to the south-eastward, the distance being as tained by pacing.

Gneiss: Trap dykes.

Soil.

Throughout the whole of the country traversed from Lake Missina gneiss, with trap dykes cutting it, were the only rocks met with. thè Wi-a-sitch-a-wan Falls at the mouth of the river, the gneiss, wh is grey and reddish-grey, and coarse in texture, runs S. 80° W., and cut by a large dyke, having the same direction. Similar varietie gneiss continued to and around Little Missinaibi Lake, the strike be from S. 10° E. to S. 40° E., averaging about S. 20° E. The dykes which several were seen cutting the gneiss, appear to run about S. W. To the south-eastward of the lake, the strike of the gneiss is m variable, being from S. S. W. to W. N. W. The country just descri was mostly of a rocky character, but Mr. Molson noticed some tracts tolerably good soil. Near the Wi-a-sitch-a-wan Falls a light-colou clay was observed between the ridges of gneiss.

Head waters of Michipicoten and Magpie Rivers.

Superficial Geology, Soil, &c. The country around the lakes at heads of the Michipicoten, Magpie and Kabinakagami Rivers is genera hilly and broken. Some patches of fair land, mostly of sandy gravelly loam, were found among the hills in the neighborhood of these lakes. The valleys of the Oba and Kabinakagami Rivers are ov spread with fine stratified sands which often contain much clay.

top of these deposits the soil usually appears to be good, but in some places it is of too light a character. Along the latter stream, the banks of sand sometimes attain a height of fifty feet and upwards, especially in the lower twenty or thirty miles examined. For a few miles above our turning point, a yellowish-drab clay, affording a good soil, was found on either side of the river.

Kapuskasing and Trout Rivers.

Coarse and fine sand.

In the country examined between the Missinaibi and Kapuskasing Rivers, much of the land is of a coarse sandy nature, broken here and there by ridges and knolls of rock, but in the valley of the latter stream there appears to be a considerable proportion of loamy and fine sandy soil of fair quality.

Enormous boulders.

Ridges and conical hills of gravel and sand

On the east side of Trout River, about twelve miles above its junction with the Kapuskasing, two enormous boulders, each as large as an ordinary settler's house, were seen perched on a low hill a short distance from the water. From the outlet of Trout Lake, for a distance of about ten miles downward, the river which flows with a gentle current, is closely flanked on either side by sharp ridges and conical hills of gravel and sand rising to a height of about 100 feet. The ridges follow the course of the valley and behind them, long ponds and lagoons are situated, having generally openings of greater or less width connecting them with the river.

NOTE.

In reference to the plan of the Moose River mouth, prepared by Dr. Bell, there appears to be some doubt of its accuracy, and in publishing it, I think it right to state what Dr. Rae, who lived there some forty years ago, has written me respecting it. The following are extracts from his letters to me dated London, 27th June, '83, and 20th Nov., '83:

"I am glad you sent me the copies of the proposed maps of Moose River, in which I have put in very roughly the corrections required.

"There are, or were in my day, two Islands to the N. W. of 'Inner Ship Hole' called the Ship Sands, and these Islands were separated from the N. W. shore of the river by a deep and swift stream, which occupied about twenty minutes to paddle across in a canoe. Spring tides aided by a gale sometimes covered these Islands with several feet of water. If the Moose River is, as your map shows it to be, the islands where we camped must have been well inland on the main shore of the left bank."

Nov. 20th.—"In reply to your enquiry, I must say that it is possible by some convulsion of nature, that the north branch of the river may have ceased to exist, but in the usual course of things such an event was not at all likely. You may make this north branch even wider than I showed it in the rough sketch I sent you, unless the ship sands have greatly increased in width."

In the map now published, it will be observed that there is no *north branch* and that the main shore of the left bank comes close out to the "*Inner Ship Hole*" and includes the islands mentioned by Dr. Rae.

It may be, however, that Dr. Rae's recollection of it as it was forty years ago, and Dr. Bell's map of it as it is now, are both correct. A comparatively small elevation of the coast, aided by a silting up of the channel, effected by fluvial and tidal currents and wind, would suffice in the lapse of forty years to produce even greater changes in a river delta without any occurrence which could be correctly designated as a "convulsion of nature." Dr. Bell has already shewn * that there are other reasons for assuming that the shores of Hudson Bay are slowly rising, or, as he states it, that the water is receding.

ALFRED R. C. SELWYN.
Ottawa, 3*rd Dec.*, 1883.

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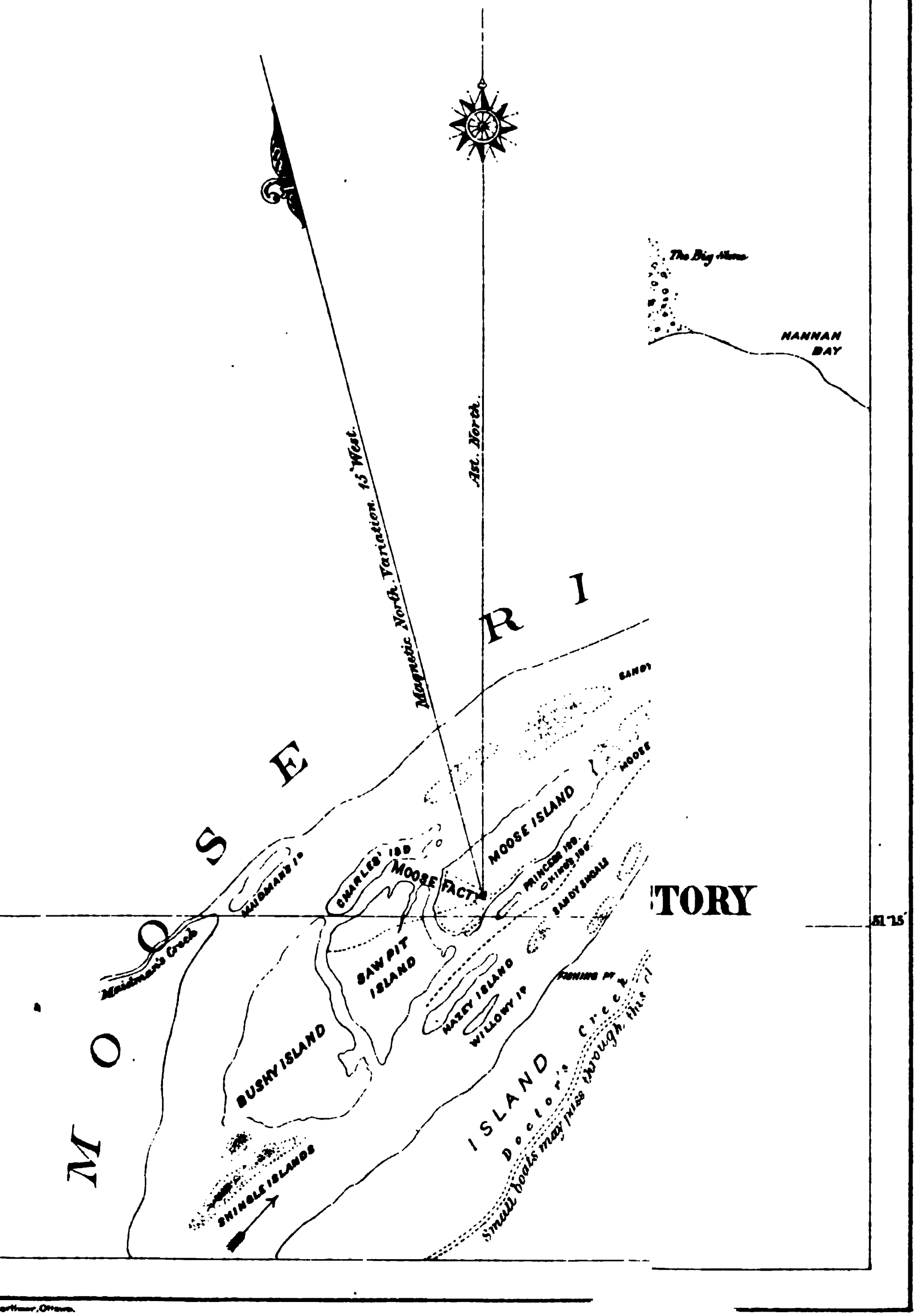
*Report of Geol. Survey of Canada: 1877-78, p. 32 c. and 25 c.c.

The water in James Bay in the vicinity of the mouth of Moose River is somewhat
The rise and fall at spring tides is about ten feet; at neaps about six feet.
High water at full and change of moon XII o'clock.
Sea going ships come to the Inner Ship Hole from the direction of A. Elsewhere
• *sand and mud bottom:*
The dotted line from the Inner Ship Hole indicates the channel followed by sch
The head of tidewater is about eight miles above Moose Factory or twenty miles,
The continuous shore lines indicate the ordinary high tide mark. Extraord
occasionally flood back to the line of bushes.



rtimer, Ottawa.

II.

ON THE GEOLOGY OF

THE LAKE OF THE WOODS

AND ADJACENT COUNTRY.

BY

ROBERT BELL, LL.D., M.D., C.E.

The geological explorations which had been made previous to 1881 in he country between Lake Superior, on the one hand, and Lake Winnipeg nd the valley of the Red River on the other, had been accomplished by llowing the numerous canoe-routes leading through it in different rections, and examining the shores of the lakes and rivers, as well as y making short journeys inland from their banks. The Canadian Pacific Railway now traverses this region and passes through large tracts which are not easily accessible by canoe. It was so far completed in 1881 as to admit of our following the line throughout and thus enabling us to ascertain many new facts in regard to the geological structure and the geographical distribution, in these parts, of the Laurentian and Huronian systems. The cuttings along the track afforded excellent opportunties for examining fresh sections of the rock.

Geological examination of the line of the Canadian Pacific R. R.

Before proceeding with a continuation of the geological exploration of the Lake of the Woods, which had been begun in previous years (See Reports for 1872 and 1873), a cursory examination was made of the railway track from English River to Cross Lake. This work was performed by Mr. Molson in the section between Wabigoon Lake and Rat Portage, and in the other sections by myself. The same gentleman explored the Wabigoon and part of the Eagle River, whilst I made a track-survey from Wabigoon Lake to Lake of the Woods by way of the Three-fork River, Eagle, Vermilion and Bell's Lakes. This was followed by a geological examination of the northern part of the Lake of the Woods and of Shoal Lake and Whitefish Bay, with track-surveys of the parts travelled over.

English River.

In going westward from English River along the track of the Cana-

Butler.
Bonheur.
Falcon.

dian Pacific Railway, Laurentian gneiss continues to a point between Butler and Raleigh Stations. It is nearly all of dark-grey shades, and the prevailing strike is between W. S. W. and S. W. Between Bonheur and Falcon Stations, it is conspicuously banded or ribboned, the layers consisting of various shades of grey, with some of red. At the former station and for a short distance west the strike is S. 75° W., but for the remainder of the interval, about ten miles, it is S. 45° W., and the dip is to the south-east at an angle of about 70°. Between Gull River and Falcon Station, the gneiss, which is very dark and hornblendic, passing into schist, is very largely mixed with coarse and fine red felspathic granite. At two miles, and continuing thence for three miles west of Ignace Station, the rock is very massive grey gneiss, or possibly a granite, as no distinct stratification could be detected.

Huronian schists near Raleigh.

Taché.

Bois Brulé.

The last gneiss was seen at the Y, three miles west of Butler Station and at about one mile and three-quarters east of Raleigh, dark-green fine hornblende schist, which is considered Huronian, makes its appearance. The strike is north-westward, quite parallel to the railway track and the dip is south-westward at an angle of 65° to 70°. A similar rock with the same strike, was observed two miles west of Raleigh, while at four miles there is a dark, greenish-grey, silicious schist, and a lighter grey felspathic schist, all associated with a few thin, rusty, calcareous beds. Here the strike is more nearly north, but at one mile and a-hal further west, where the felsitic schists are more largely developed, the strike is again north-westward. These rocks are followed immediately to the westward by dark-greenish silicious and chloritic schists, having the same strike. Next, slaty diorites were met with, becoming more massive in going westward, to a point three and a-half miles east of Taché Station, where they are succeeded by grey syenitic granite of medium texture, which has a breadth of a mile and a-half on the track Green schists were observed at one mile west of Taché, beyond which the rocks for a number of miles are concealed by drift. In the neighborhood of Bois Brulé Station, the rocks, which strike north-westward consist of soft, green schists, with strings of calcspar and quartz Where the railway crosses the narrows of a small lake a mile or two west of this station, there is a cutting through dark, bluish-grey, soft and hard dioritic schists, with strings of brown-weathering calcspar Quartz, epidote and iron pyrites also occur in these rocks. In another cutting, a short distance further west, the rock is a dioritic conglomerate Between this point and Little Wabigoon Lake a variety of dioritic rocks were met with, consisting of massive and slaty forms, of various shades of bluish-green, grey, bluish, and greenish-grey. The dioritic schists generally contain much calcspar in the form of strings and spots Slaty dioritic rocks running north-westward, or with the track, were ob served here and there as far as Elm Bay on (Big) Wabigoon Lake, around the head of Little Wabigoon Lake, and in various localities along the track as far east as Taché, and as far west as Eagle River, there is a considerable thickness of stratified, drab clay, with an occasional reddish band. In some places the stratification of the clay was observed to dip at high angles. Small nodules of curious forms are sometimes found in it.

Wabigoon River to Rat Portage.

Gneiss. Schists.

From the Wabigoon River to within about nine miles of Rat Portage, Mr. Molson found only Laurentian gneiss, with the exception of a narrow band of argillaceous slate near the north-east corner of Feist Lake, and a belt of hornblende schist, about one mile wide, with a northward strike, crossing the track opposite the end of Dog-tooth Lake. The strike of the gneiss varied much, but in the majority of cases it approached either a westward or a south-westward course. At nine miles before reaching Rat Portage, and continuing thence for two or three miles, a coarse grey syenitic granite prevailed. Between this and the village of Rat Portage, the rocks are principally fine-grained, somewhat calcraeous, hornblende schist, in which the jointing is well marked, but there are also felsitic, dioritic and silicious schists. The average direction of the strike is south-westward. A tough, greenish-grey, hornblendic rock, containing occasional patches of asbestus, occurs a short distance west of the outlet at Rat Portage.

Boundary between Laurentian and Huronian, north of Lake of the Woods.

The line between the Laurentian and the Huronian systems, which crosses the Winnipeg River at Rat Portage, keeps near the railway to a point between Lake Lulu and Keewatin Mills, where it crosses it diagonally and continues thence in a westerly direction on the south side of the track.

Lake Deception to Cross Lake.

From Lake Deception to Cross Lake the Laurentian gneiss is generally dark grey and red, rather massive, much contorted and cut by numerous veins of red and grey granite; while from Cross Lake for some distance westward, it is reddish in colour, thinly bedded, and runs with great regularity nearly parallel to the railway, the dip being to the north at moderate angles.

Probable dislocation.

It is probable that a line of dislocation or disturbance, which may be connected with the granites of Lake of of the Woods and the Winnipeg River, runs north-westward through Cross Lake. The decomposition of the rock along this line, followed by the denuding agencies of the glacial period, have probably been the means of scooping out the deep channel of this lake, which caused so much trouble in attempting to carry the line of the Pacific Railway across it.

Exploration from Wabigoon Lake by Eagle, Vermilion and Bell's Lake to Lake of the Woods.

Returning now to Wabigoon Lake, a short account will be given of the explorations by water which have been referred to. In descending the Wabigoon River to its junction with the Eagle River and in ascending the latter stream, Mr. Molson found only Laurentian gneiss, until coming to the outlet of Eagle Lake, where the Huronian schists begin. Their strike is here S. S. W.

Three-fork River.

Lakes S.E. of Eagle Lake.

Huronian rocks of Eagle Lake.

In regard to the exploration from Wabigoon Lake by way of Eagle Vermilion and Bell's Lakes to Lake of the Woods, the rocks will b mentioned in the order in which they were examined. Around Wabigoon Lake, green dioritic and chloritic schists prevail. I was shown a smal specimen of native copper in quartz, said to have been broken from vein on an island in this lake. In the southern bay of the lake and along the Three-fork River, as far as the second small lake on its course a massive, grey diorite appears to be the only rock. From this lake portage, three quarters of a mile long, leads south-westward to a larger one, the waters of which eventually find their way into Eagle Lake The northwest side of this lake is occupied with Laurentian gneiss Lying to the south-east of Eagle Lake, proper, are two straggling sheet of water connected with each other by tortuous narrows, five or six miles long. The second and larger of these was called, for convenience Hugh Osbourne's Lake. It is separated from the south-eastern bay o Eagle Lake by narrows only a few yards wide, and here the Huronian schists re-appear; the two straggling lakes mentioned being surrounded by hills of gneiss. Three miles north of the narrows by which we entered Eagle Lake, another narrow place was passed. Here the rock is a light grey calcareous mica-schist on edge, and running S. 30° W. Along the south-east side of the lake, dark-grey diorites, for the most part of massive character, predominate, except in the last four miles before reaching the south-western extremity, where they are replaced by a grey syenitic granite of medium texture. At a mile and a-half north of the south-eastern extremity, a light-grey, slaty felsite was met with in a vertical attitude and striking S. 35° W. A narrow passage connects the western arm of Eagle Lake with the south-west end of Vermilion Lake. The rock at this place is a grey mica-schist full of iron pyrites. The ground is covered with red ochre resulting from the decomposition of the pyrites by bush fires and the action of the weather. The schists contain numerous short veins of red and white quartz (also holding iron pyrites), following the strike, which runs S. 45° W.

Laurentian gneiss of Vermilion and Bell's Lakes.

Passing into Vermilion Lake through the passage already mentioned, at half a mile north of the western arm of Eagle Lake, Laurentian gneiss was again encountered and was the only rock met with along the route followed, until reaching the portage on Berry River, about a mile east of the head of Long Bay at the eastern extremity of the northern part of the Lake of the Woods. Here again schists and calcareous, light-grey micaceous quartzites were found, striking west, which proved to be connected with the large Huronian basin of this lake.

The gneiss all along the above route is of the ordinary greyish and reddish varieties, and requires no special description. The country visible from this chain of lakes on either side is mostly rocky and barren and nearly all the timber has been burnt off.

Gneiss of Whitefish Bay.

The shores and islands of Whitefish Bay were found to consist of Laur-ntian gneiss, except along the northern side and near Turtle Portage t the southern extremity. About a mile and a-half north of this portage ark-grey mica-schist and fine hornblende schist, running south-westvard, are seen on both sides of the bay in contact with the gneiss.

Schists of Shebaskong Bay.

According to the late Dr. Bigsby, the shores and islands of Shebaskong 3ay are occupied by a variety of schists, which are now included in the Iuronian system, (see Journal of the Geological Society of London, Vol. 8). Green schists, with a westward strike, are seen in contact with he gneiss in the northern part of Whitefish Bay.

Huronian rocks of Lake of the Woods.

The subdivisions of the Huronian system, which is well developed round the northern part of Lake of the Woods and Shoal Lake, are xplained more concisely and usefully for reference by means of the ccompanying geological map and the notes upon it, than would be ossible in any other way; and it is, therefore, unnecessary here to epeat these descriptions. At the time of our visit, no mining operations vere going on at the Lake of the Woods, although some openings, in earch of gold, had lately been made. Owing to the want of guides and he lateness of the season, it was found impossible to examine the various ocalities at which more or less work had been done. In 1879 I was resented by Mr. J. Dewe with a specimen from Hay Island, of white uartz, containing needle-like crystals of hornblende, with a little alcspar, which showed distinct specks of gold. It was assayed by Mr. Ioffman, chemist to the survey, and found to contain 37.318 ounces of old and 1.431 ounces of silver to the ton of 2000 pounds [Report of rogress for 1878-79, page 33 H.]. We were shown specimens of copper yrites in quartz and clay-slate, of galena in quartz and of magnetic iron ssociated with jasper, all said to have been found in the eastern part of e northern division of the Lake of the Woods.

Gold.

Copper.

Lead.

Botanical and entomological collections.

The botanical collection of the year, of which a list is given in the ppendix, was made almost entirely in the region explored during the arlier part of the season. Lists are also given of the coleoptera colcted, not only in the regions explored, but also of those which had been btained at Oxford House, and a collection kindly made for me by Mr. Villiam Isbister at Nelson River House, as well as of Mr. Cochrane's ollections from the region which he traversed, between the Nelson and e Athabasca Rivers. We are greatly indebted to Dr. J. L. LeConte of hiladelphia for his kindness in having determined the species in all the bove collections. His lists will be found in the appendix.

APPENDIX I.

CATALOGUE

By John Macoun, M.A., F.L.S., F.R.S.C.,

(Botanist to the Survey,)

THE PLANTS COLLECTED BY DR. ROBERT BELL ALONG THE MICHIPICOTEN RIVER AND IN THE SOUTHERN PART OF THE BASIN OF MOOSE RIVER,

In July, August and September, 1881.

e collection affords scarcely any indications of a boreal climate.
greater number of the species are the commoner plants of central
rio. For the purpose of making a comparison between the two
ns, the county of Hastings is selected because its flora is most
iar to the writer. The species found in this county are indicated
e fourth column of the catalogue. It may be observed that they
sent largely the flora of rivers and river margins rather than the
away from their banks. Many of the bog plants are absent,
h indicates either a comparatively dry region, or that the bogs
not traversed. Plants peculiar to a dry limestone soil are absent.
the climate of the tract of country traversed is much warmer than
n the immediate vicinity of Lake Superior is indicated by the
ce of many species which make their home there.

e species in this collection which have been found along the
gian Bay or Lake Superior, but not in central Ontario, are the
ving. Those marked with a star are found on the lower St.
ence, and those with a dash extend westward to and beyond
toba.

—* Hedysarum boreale.
— Vicia Americana.
—* Potentilla tridentata.
Crataegus tomentosa var. pyrifolia.
—* Parnassia palustris.

— Saxifraga tricuspidata.
— Symphoricarpus racemosus, var. pauciflorus.
—* Lonicera involucrata.
— " parviflora var. Douglasii.
—* cœrulea.
—* Viburnum pauciflorum.
—* Aster graminifolius.
—* Nabalus racemosus.
—* Vaccinium cæspitosum.
—* Pinguicula vulgaris.
— Mertensia paniculata.
Gentiana alba.
—* Halenia deflexa.
—* Comandra livida.
—* Indum erectum var. declinatum.
— Tofieldia glutinosa.
—* Streptopus amplexifolius.
—* Allium Schœnoprasum.
—* Eleocharis tenuis.
—* Carex capillaris.
—* Aspidium fragrans.
—* Woodsia glabella.
—* Stereocaulon paschale.

The foregoing list gives all the species in the collection which not found in Hastings county, so that the western range of the sp is the only point worthy of consideration. Many of these exten and beyond the Rocky Mountains, and a few to the Pacific Ocean. It curious fact that Lake Superior seems to be the eastern limit of n western forms. At present no other cause can be adduced for it the increased humidity of the air. Vicia, Parnassia, Saxifraga, I cera involucrata, Viburnum, Vaccinium, Mertensia, Comandra, Hal Streptopus, Allium, and Carex cross the Rocky Mountains, and found in great luxuriance in northern British Columbia. A few r the Pacific coast, and seem as much at home there as they d Thunder Bay. Of these the Vicia, Lonicera, and Mertensia are most common, and scarcely undergo the slightest change in degrees of longitude. Many others, which do not appear in the could be cited as ceasing to grow at the western end of Lake Supe and eastern species, especially shrubs and trees, have their wes limit there. Much remains to be done in determining the geograp distribution of species, and no place will so well repay examinati this connection as the western end of Lake Superior.

Only two doubtful or unique forms were detected. These we phar and a Hieracium. The former may be a variety of N. advena, t I am tempted to believe it is N. luteum, which has been lately nd at Ottawa by Mr. J. Fletcher. The Hieracium is possibly a form H. Canadense, but future collections must decide that, as the present ecimen is too imperfect to determine this point.

The columns in the catalogue refer to the localities in which these nts were collected, as follows :

I.—Michipicoten River from the Long Portage to Lakes Mattawagaming and Wabatongwashene.

II. —Oba Lake and River, and Kabinakagami Lake and River.

III.—From Missinaibi House to Flying Post.

IV.—County of Hastings for comparison.

s.		I.	II.	III.	IV.
	RANUNCULACEÆ. (*Crowfoot family*).				
1	Clematis verticillaris, DC.	•			*
2	Anemone Pennsylvanica, Linn.		*		•
3	Thalictrum purpurascens, Linn	•			•
4	" Cornuti, Linn.	•			•
5	Ranunculus aquatilis, var. trichophyllus, Cham		•		•
6	" Flammula, L. var. reptans, Gr	•			•
7	" repens, Linn	•	•		•
8	Caltha palustris, Linn		•		•
9	Coptis trifolia, Salisb			2	•
0	Aquilegia Canadensis, Linn.			1	•
1	Actæa spicata, L. var. rubra, Gr		•		•
2	" alba, Bigel.	•		1	•
	NYMPHÆACEÆ. (*Pond Lily Family*).				
3	Brasenia peltata, Pursh		1		•
4	Nymphæa odorata, Ait		1		•
5	Nuphar advena, Ait.	•			•
6	" luteum ? Smith	•			
7	" luteum, Smith, var. pumilum, Gr.		•	1	•
	SARRACENIACEÆ. (*Pitcher Plant Family*).				
8	Sarracenia purpurea, Linn		•		•
	FUMARIACEÆ. (*Fumitory Family*).				
9	Corydalis glauca, Pursh.	*	•		•
	CRUCIFERÆ. (*Mustard Family*).				
0	Nasturtium palustre, DC		*		•
1	Cardamine hirsuta, Linn.		•		•
2	Arabis Drummondi, Gray.	•			•

Nos.		I.	II.	III.
	VIOLACEÆ. (*Violet Family*).			
23	Viola blanda, Willd	•		
24	" cucullata, Ait	•		
25	" canina, L. var. sylvestris, Reg			1
	DROSERACEÆ. (*Sundew Family*).			
26	Drosera rotundifolia, Linn	•		
	HYPERICACEÆ. (*St. John's Wort Family*).			
27	Hypericum Canadense, Linn			2
28	Elodes Virginica, Nutt			2
	GERANIACEÆ. (*Geranium Family*).			
29	Geranium Carolinianum, Linn	•		2
30	Impatiens fulva, Nutt		•	2
31	Oxalis acetosella, Linn	•		
	RHAMNACEÆ (*Buckthorn Family*).			
32	Rhamnus alnifolius, L'Her	•	•	
	SAPINDACEÆ. (*Maple Family*).			
33	Acer spicatum, Lam	•		
34	" rubrum, Linn	•		
	LEGUMINOSÆ. (*Pea Family*).			
35	Trifolium repens, Linn		•	
36	Hedysarum boreale, Nutt		•	
37	Vicia Americana, Muhl		•	
38	Lathyrus ochroleucus, Hook	•	•	
	ROSACEÆ. (*Rose Family*).			
39	Prunus Virginiana, Linn		•	
40	" Pennsylvanica, Linn	•		
41	" pumila, Linn	•		
42	Spiræa salicifolia, Linn	*		
43	" opulifolia, Linn	•		
44	Geum macrophyllum, Willis	•		
45	" strictum, Ait	•	•	
46	" rivale, Linn	•		
47	Fragaria Virginiana, Ehrh	•		
48	Potentilla arguta, Pursh	•		
49	" anserina, Linn		•	
50	" fruticosa, Linn	•		1
51	" tridentata, Ait	•		
52	" palustris, Scop	•		
53	Rubus triflorus, Rich	•	•	
54	" strigosus, Michx	•		
55	Rosa blanda, Ait	•		

	I.	II.	III.	IV.
ROSACEÆ. (*Rose Family*).—(*Continued.*)				
ægus tomentosa, L. var. pyrifolia, Gr. Also at Sault Ste. Marie	•		(E)	
elanchier Canadensis, Torr and Gr.	•			•
us Americana, DC.	•			•
SAXIFRAGACEÆ. (*Saxifrage Family*).				
s hirtellum, Mx		•		•
lacustre, Poir	•	•		•
rubrum, Linn	•	•	2	•
assia palustris, Linn		•	(25)	
fraga tricuspidata, Retz			(W)	
lla nuda, Linn	•			•
HALORAGEÆ.				
ouris vulgaris, Linn		•		•
iophyllum heterophyllum, Mx	.		1	
ONAGRACEÆ. (*E. Primrose Family*).				
ra alpina, Linn	*	•		•
obium angustifolium, Linn	•		(W)	•
" palustre, Linn	•			•
" " var. lineare, Gr.	•			•
" tetragonum, Linn	•			•
" coloratum, Muhl	•			•
UMBELLIFERÆ. (*Parsley Family*).				
cula Marilandica, Linn	•			*
cleum lanatum, Michx	•			•
ta bulbifera, Linn			1	
lineare, Michx	•			•
orhiza brevistylis, DC.	•			•
ARALIACEÆ. (*Ginseng Family*).				
ia nudicaulis, Linn	•			•
hispida, Michx		•		•
CORNACEÆ. (*Dogwood Family*).				
us Canadensis, Linn	•		(W)	•
stolonifera, Michx	•	•		•
CAPRIFOLIACEÆ. (*Honeysuckle Family*).				
æa borealis, Gronov	•			•
phoricarpus racemosus, Mx. var. pauciflorus (Robbins)	•			
icera involucrata, Banks		•		
" parviflora, Lam, var. Douglasii, Gr	•	•	2	
" cœrulea, Linn		•		
" oblongifolia. Muhl	•		1	•
" ciliata, Muhl	•	•		•

Nos.		I.	II.	III.
	CAPRIFOLIACEÆ. (*Honeysuckle Family*).—(*Continued.*)			
89	Lonicera hirsuta, Eaton		•	1
90	Diervilla trifida, Mœnch	•		
91	Sambucus pubens, Michx	•		
92	Viburnum pauciflorum, Pylaie		•	
93	" opulus, Linn	•		
	RUBIACEÆ. (*Madder Family*).			
94	Galium triflorum, Michx	•	•	1
95	" trifidum, Linn	•		2
96	" asprellum, Michx			1
	COMPOSITÆ. (*Composite Family*).			
97	Eupatorium purpureum, Linn	•	•	
98	Nardosmia palmata, Hook	•		
99	Aster simplex, Willd			1
100	" æstivus, Ait		•	
101	" cordifolius, Linn		•	
102	" graminifolius, Torr and Gray		•	
103	" macrophyllus, Linn	•	•	
104	" puniceus, Linn	•	•	
105	Diplopappus umbellatus, Torr and Grey			1
106	Solidago lanceolata, Ait	•		1
107	" Virga-aurea, L. var. Alpina, Rig			(W)
108	" Canadensis, Linn			1
109	" nemoralis, Ait	•		
110	" latifolia, Linn	•		
111	Achillæa millefolium, Linn	•		
112	Antennaria plantaginifolia, Hook	•		
113	" margaritacea, R. Br	•		
114	Senecio aureus, Linn, var obovatus, T. & G	•		
115	" " var borealis, T. & G			(W)
116	Cirsium muticum, Michx	•		
117	Hieracium Canadense, Michx	•	•	
118	" ———?			1
119	Nabalus racemosus, Hook		•	
120	Taraxacum dens-leonis, Desf	•		
121	Mulgedium leucophæum, DC	•	•	
122	Lactuca Canadensis, Linn	•		
	LOBELIACEÆ. (*Lobelia Family*).			
123	Lobelia Kalmii, Linn			
	CAMPANULACEÆ. (*Campanula Family*).			
124	Campanula aparinoides, Michx		•	
	ERICACEÆ. (*Heath Family*).			
125	Vaccinium cæspitosum, Michx	•		
126	" Canadense, Kalm	•		
127	" Oxycoccus, Linn		•	
128	" Pennsylvanicum, Linn	•		

	I.	II.	III.	IV.
ERICACEÆ. (*Heath Family*).—(*Continued.*)				
Chiogenes hispidula, Torr and Gray			1.2	•
Arctostaphylos uva-ursi, Spreng		•		•
Epigæa repens, Linn	•		1	•
Gaultheria procumbens, Linn			1	•
Cassandra calyculata, Don			2	•
Andromeda polifolia, Linn		•		•
Ledum palustre, Linn			(W)	
" latifolium, Ait		•		•
Pyrola secunda, Linn		•		•
" rotundifolia, Linn		•		•
" elliptica, Nutt			(W)	•
Moneses uniflora, Gray		•	2	•
Monotropa uniflora, Linn	•			•
AQUIFOLIACEÆ. (*Holly Family*).				
Nemopanthes Canadensis, D C.	•			•
PLANTAGINACEÆ. (*Plaintain Family*).				
Plantago major, Linn		•		•
PRIMULACEÆ. (*Primrose Family*).				
Primula Mistassinica, Michx		•		
Trientalis Americana, Pursh	•			•
Lysimachia thyrsiflora, Linn		•		•
" stricta, Ait	•	•		•
LENTIBULACEÆ. (*Bladderortw Family*).				
Utricularia vulgaris, Linn			2	•
Pinguicula vulgaris, Linn		•		
SCROPHULARIACEÆ. (*Figwort Family*).				
Mimulus ringens, Linn		•		•
Veronica Americana, Schw		•		•
" scutellata, Linn	•		2	•
Melampyrum Americanum, Michx	•	•		•
LABIATÆ. (*Mint Family*).				
Mentha Canadensis, Linn	•		2	•
Lycopus Virginicus, Linn		•	1	•
" sinuatus, Gray	*	•		•
Calamintha Clinopodium, Benth	•			•
Brunella vulgaris, Linn	•			•
Scutellaria galericulata, Linn	*		(1w)	•
" lateriflora, Linn		•		•
BORAGINACEÆ. (*Borage Family*).				
Mertensia paniculata, Don	•			

Nos.		I.	II.	III.	I
	GENTIANACEÆ. (*Gentian Family*).				
162	Gentiana alba, Michx			1	
163	Halenia deflexa, Griesb		•		
164	Menyanthes trifoliata, Linn		•		
	APOCYNACEÆ. (*Dogbane Family*).				
165	Apocynum androsæmifolium, Linn	•			
	OLEACEÆ. (*Olive Family*).				
166	Fraxinus sambucifolia, Lam	*			
	POLYGONACEÆ. (*Buckwheat Family*).				
167	Polygonum tenue, Michx	•			
168	" amphibium, var. aquaticum, L		•		
169	Rumex orbiculatus, Gray		•	2	
170	Fagopyrum esculentum, Mœnch	•			
	SANTALACEÆ. (*Sandalwood Family*).				
171	Comandra livida, Rich		•		
	CALLITRICHACEÆ. (*Water Starworts*).				
172	Callitriche verna, Linn		•		
	URTICACEÆ. (*Nettle Family*).			1	
173	Urtica gracilis, Ait			E	
174	Celtis occidentalis, Linn, Eagle Lake, Lat. 49° 45′, Long. 93° 15′				
	CUPULIFERÆ.				
175	Quercus alba, Linn. At Sault Ste. Marie				
176	" rubra, Linn. On east side of Lake Superior, as far north as Agawa River; on west side as far north as the Kaministiquia River		•		
177	" macrocarpa, Michx. In going west, this species is first met with at the east end of Eagle Lake				
178	Corylus rostrata, Ait	•			
179	Ostrya Virginica, Willd, around Lake of the Woods				
	MYRICACEÆ.				
180	Myrica Gale, Linn	•			
	BETULACEÆ. (*Birch Family*).				
181	Betula pumila, Linn			1	
182	" papyracea, Ait	•			
183	Alnus incana, Willd	•			

	I.	II.	III.	IV.
SALICACEÆ. (*Willow Family*).		•		•
Salix candida, Willd	•	•		•
" discolor, Muhl				
" livida var. occidentalis, Gray		(W)		•
" lucida, Muhl	•	•	1	•
" longifolia, Muhl		•		•
" myrtilloides, Linn		•		•
Populus tremuloides, Michx		•		•
" balsamifera, Linn		•		•
CONIFERÆ. (*Pine Family*).				
Pinus Banksiana, Lamb			1	•
" resinosa, Ait			1	•
" strobus, Linn.			1	•
Abies balsamea	•			•
" alba	•			•
Larix Americana, Michx	•			•
Thuja occidentalis, Hook	•			•
Taxus baccata, L. var. Canadensis, Gray	•			•
uniperus communis, Linn		•		•
ARACEÆ. (*Arum Family*).				
Acorus calamus, Linn		•		•
Calla palustris, Linn		•	(2w)	•
TYPHACEÆ. (*Cat-tail Family*).				
parganium eurycarpum, Engelm			2	•
" simplex, Huds		•		•
" " var. angustifolium, Gr		•		•
Typha latifolia, Linn			1.2	•
NAIADACEÆ. (*Pond-weed Family*).				
Potamogeton amplifolius, Tuck			1	•
" compressus, Linn		•		•
" gramineus, L. var. heterophyllus		•		•
" natans, Linn			2	•
" pectinatus, Linn			1	•
" Robbinsii, Oakes		•		•
" rufescens, Schrad	•			•
ALISMACEÆ. (*Water-plantain Family*).				
Triglochin maritimum, L. var. elatum, Gr		•		•
agittaria variabilis, Engelm		•		•
" " var. obtusa, Gr		•		•
lisma Plantago, L. var. Americanum, Gr			1	•
ORCHIDACEÆ. (*Orchis Family*).		•		•
Habenaria Hookeri, Torr	•	•	1	•
" hyperborea, Lindl	•		2	•
" obtusata, Rich	•		2	•

Nos.		I.	II.	III.
	ORCHIDACEÆ. (*Orchis Family*).—(*Continued.*)			
221	Goodyera repens, R. Br.			1
222	Spiranthes Romanzoviana, Cham		•	
223	Corallorhiza innata, R. Br.	•		
224	" multiflora, Nutt.			1
225	" Macræi, Gray			1
226	Cypripedium pubescens, Willd.			
	IRIDACEÆ. (*Iris Family*).			
227	Iris versicolor, Linn	•		
228	Sisyrinchium Bermudianum, Linn	•	•	
	LILIACEÆ. (*Lily Family*).	*		1·2
229	Trillium erectum, L. var. declinatum, Gr.	• •		
230	Tofieldia glutinosa, Willd	•		
231	Streptopus amplexifolius, D.C.	•		
232	" roseus, Michx.	•		
233	Clintonia borealis, Desf.	•		
234	Smilacina trifolia, Desf.	•		2
235	" bifolia, Ker.			
236	Lilium Philadelphicum, Linn	•		
237	Allium Schænoprasum, Linn.	•		
	JUNCACEÆ. (*Rush Family*).			
238	Luzula parviflora, var. melanocarpa, Gr.		•	
239	Juncus effusus, Linn	•		
240	" tenuis, Willd.		•	
	CYPERACEÆ. (*Sedge Family*).			•
241	Dulichium spathaceum, Pers	•		1
242	Eleocharis palustris, R. Br.	•		
243	" tenuis, Schultes	•		
244	Scirpus validus, Vahl	•		
245	" microcarpus, Prest		•	
246	" subterminalis, Torr		1	
247	Eriophorum Virginicum, Linn		1	
248	Carex adusta, Boot.	•		
249	" aurea, Nutt.		•	
250	" capillaris, Linn	•		
251	" Houghtonii, Torr.	•		
252	" lenticularis, Michx	•		
253	" monile, Tuck	•		
254	" polytrichoides, Muhl.	•		
255	" straminea, Schk		•	
256	" tenella, Schk.		•	
257	" retrorsa, Schw		•	
258	" irrigua, Smith.			1
	GRAMINEÆ. (*Grass Family*).		•	1
259	Zizania aquatica, Linn	•		
260	Phleum pratense, Linn.			1

	I.	II.	III.	IV.
GRAMINEÆ. (*Grass Family*).—(*Continued.*)				
rostis scabra, Willd		●	1	*
na arundinacea, Linn		●		●
hlenbergia glomerata, Trin	●	●		●
amagrostis Canadensis, Beauv			1	●
ceria aquatica, Smith			1	●
" fluitans, R. Br	●			●
mus ciliatus, Linn			1	●
agmites communis, Trin	●			●
ticum repens, Linn	●			●
thonia spicata, Beauv	●			●
a cœspitosa, Linn	●	●		●
setum subspicatum, var. molle, Gray	●			●
EQUISETACEÆ. (*Horse-tail Family*).				
isetum arvense, Linn	●			●
" limosum, Linn		●		●
" hyemale, Linn			2	●
" scirpoides, Michx	●			●
FILICES. (*Fern Family*).				
ypodium vulgare, Linn	●			●
ris aquilina, Linn	●			●
lenium trichomanes, Linn			1	●
" Filix-fœmina, Bemh	●	*	1	●
gopteris polypodioides, Feè	●		1	●
" Dryopteris, Feè	●			●
idium fragrans, Swartz			1·2	
" cristatum, Swartz			B.L.	●
" spinulosum, Swz. var. intermedium, Gr	●			●
" " var. dilatatum, Gr		●		●
clea sensibilis, Linn	●			●
topteris fragilis, Bernh	●			●
" bulbifera, Bernh	●		1	●
odsia Ilvensis, R. Br	●		1 BL	●
" ——— ?	●			
unda regalis, Linn	●			●
" Claytoniana, Linn	●			●
rychium Virginicum, Swartz	●		2	●
LYCOPODIACEÆ. (*Club-moss Family*).				
opodium annotinum, Linn	●			●
" dendroideum, Michx	●			●
" clavatum, Linn	●			●
" complanatum, Linn			2	●
MUSCI. (*Moss Family*).			1	●
agnum cymbifolium, Ehrh			1	●
" recurvum, Beauv			1	●
anum undulatum, Turner			1	●
trichum commune, Linn			1	●
um cuspidatum, Hedw		●		●

Nos.		I.	II.	III.	IV
	MUSCI (*Moss Family*).—(*Continued.*)				
304	Funaria hygrometrica, Linn		•		•
305	Hypnum Crista-castrensis, Linn		•		•
306	" Schreberi, Willd		•		•
307	" splendens, Hedw		1		•
308	" triquetrum, Linn			1	
	HEPATICÆ. (*Liverwort Family*).				
309	Marchantia polymorpha, Linn	•	•		•
310	Madotheca platyphylla, Dumort		•		•
	LICHENES. (*Lichen Family*).			2	
311	Usnea barbata, Fr			2	
312	Parmelia saxatilis, Ach		•	2	
313	Umbilicaria Dillenii, Tuck		•	2	
314	Sticta pulmonaria, Ach	•	•	2	
315	Peltigera canina, Hoffm	•	•		
316	Stereocaulon paschale, Lam		•		
317	Cladonia cornuta, Fries		•		
318	" cornucopioides, Fries		•		
319	" gracilis, Fries		•		
320	" furcata, Fries		•		

APPENDIX II.

OF COLEOPTERA COLLECTED IN 1881 BY DR. BELL ND OTHERS, IN THE LAKE SUPERIOR DISTRICT AND IN THE NORTH-WEST TERRITORIES,

st of the 112th Meridian and south of the 60th parallel.

By Dr. J. L. LeConte, Philadelphia.

species given in Lists i.-vii. were collected by Dr. Bell; those by Mr. William Isbister, and those in ix. x. xi. by Mr. A. S. ne.

only remark I have to make upon the collections examined is *hodius fimetarius* is still extending its area towards the North- This European species was first found in Maine about 1835 by l, since which time it has extended towards Georgia on the and also into the Western States. It now appears in Dr. Bell's ion of last summer, made on the route from Thunder Bay to f-the-Woods. This is, I believe, the first record of its appearance Lake Superior basin. It will therefore probably, undisturbed mies, diffuse itself over all parts of the continent, where proper d endurable climate can be found.

ult Ste. Marie (between Lakes Huron and Superior), Lat. 46° 31′, Long. 84° 20′.

indela longilabris.
“ purpurea.
“ vulgaris.
“ duodecimguttata.
trobus longicornis.
erostichus lucublandus.
“ orinomum.
“ erythropus.
nara impuncticollis.
“ obesa.
lathus impunctatus.

12. Platynus cupripennis.
13. " cupreus.
14. " obsoletus.
15. Chlænius sericeus.
16. Anisodactylus Baltimorensis.
17. Harpalus Pennsylvanicus.
18. " herbivagus.
19. " pleuriticus.
20. Stenolophus conjunctus.
21. Rhantus binotatus.
22. Leistotrophus cingulatus.
23. Philonthus æneus.
24. Silpha Americana.
25. Liodes globosa.
26. Dermestes lardarius.
27. Pediacus fuscus.
28. Epuræa rufa.
29. Nitidula bimaculata.
30. Coccinella trifasciata.
31. Anatis pullata.
32. Hister abbreviatus.
33. " depurator.
34. Dendrophilus punctulatus.
35. Saprinus Oregonensis.
36. " mancus.
37. " fraternus.
38. Platycerus depressus.
39. Onthophagus Hecate.
40. Aphodius granarius.
41. Serica tristis.
42. Lachnosterna fusca.
43. Trichius affinis.
44. Chalcophora Virginiensis.
45. Buprestis fasciata.
46. " consularis.
47. " maculiventris, form rusticorum.
48. Melanophila longipes.
49. Chrysobothris dentipes.
50. " trinervia.
51. Cryptohypnus abbreviatus.
52. Elater apicatus.
53. Agriotes mancus.
54. " fucosus.

griotes oblongicollis.
lopius lateralis.
rymbites cruciatus.
aphes memnonius.
phon variabilis.
ateros canaliculatus.
ychnia corrusca.
otinus ardens.
oturis Pennsylvanica.
dabrus puberulus.
lephorus fraxini.
" scitulus.
rus undatulus.
iocephalus agrestis.
lotrechus undulatus.
smocerus palliatus.
mæops pratensis.
ptura chrysocoma.
" pubera.
" aspera.
nohammus scutellatus.
" maculosus.
rysochus auratus.
aphops marcassita.
ryphora 10-lineata.
rysomela Philadelphica.
asocuris varipes.
apstinus moestus.
" interruptus.
athimus opacus.
is ceramboides.
nebrio molitor.
" tenebrioides.
menorus pilosus.
mira quadristriata.
thromacra ænea.
rphyra lugubris.
crobasis unicolor.
lobius pales.
" confusus.
ris confinis.
yopthorus corticalis.

II.—Mouth of Michipicoten River, Lake Superior. Lat. 47°
Long. 84° 51′.

1. Cincindela longilabris.
2. Calosoma calidum.
3. Cymatopterus sculptilis.
4. Necrophorus vespilloides.
5. Silpha Lapponica.
6. Dichelonycha Backii.
7. Dicerca tenebrosa.
8. Buprestis maculiventris.
9. Monohammus scutellatus.

III.—Head Waters of the Michipicoten River, Lake Superior. *L*
48° 30′, *Long.* 84° 00′, *to Lat.* 48° 30′, *Long.* 84° 10′.

1. Cicindela vulgaris.
2. " duodecimguttata.
3. Nomius pygmæus.
4. Pterostichus coracinus.
5. " orinomum.
6. Amara erratica.
7. Cymindis cribricollis.
8. Hydroporus inæqualis.
9. " sericeus.
10. Dytiscus Harrisii.
11. Acilius semisulcatus.
12. Cymatopterus sculptilis.
13. Ilybius confusus.
14. Gaurodytes lutosus.
15. Gyrinus limbatus.
16. " borealis.
17. " pectoralis.
18. Silpha Lapponica.
19. Cocinella picta.
20. Buprestis rusticorum.
21. Pogonocherus penicillatus.
22. Monohammus scutellatus.
23. " marmoratus.
24. Donacia subtilis.
25. Galeruca sagittariæ.
26. Blapstinus moestus.
27. Pissodes strobi (very small).
28. " dubius.

V.—*From Missinaibi House, north-east of Lake Superior, to Flying Post. Lat.* 48° 29′, *Long.* 83° 35′ *to Lat.* 48° 02′ *Long.* 82° 20′.

1. Platynus affinis.
2. " obsoletus.
3. Pterostichus coracinus.
4. " orinomum.
5. Dytiscus confluens.
6. Gyrinus confinis.
7. " affinis.
8. Silpha Americana.
9. Choleva basillaris.
0. Coccinella picta.
1. Ellychnia corrusca (very small).
2. Monohammus scutellatus.
3. Donacia proxima.
4. " hirticollis.
5. " aurea.
6. Graptodera bimarginata.
7. " (two species undetermined).
8. Penthe obliquata.
9. Stenotrachelus arctatus.

—*Oba and Kabiuakagami Lakes and Rivers, north-east of Lake Superior. Lat.* 48° 30′, *Long.* 84° 27′ *to Lat.* 49° 45′, *Long.* 83° 45′.

1. Pelophila rudis.
2. Nomius pygmæus.
3. Bembidium impressum.
4. Patrobus hyperboreus.
5. Pterostichus punctatissimus.
6. " coracinus.
7. " orinomum.
8. Amara impuncticollis.
9. Calathus ingratus.
0. Platynus metallescens.
1. " deceptivus.
2. " retractus.
3. Cymindis cribricollis.
4. Chlænius Pennsylvanicus.
5. Bradycellus cognatus.
6. Hydroporus rotundatus.
7. Dytiscus Lapponicus.
8. Cymatopterus sculptilis.

19. Agabus lutosus.
20. “ parallelus.
21. Dineutus emarginatus.
22. Choleva basillaris.
23. Epuræa immunda.
24. Trichius affinis.
25. Buprestis maculiventris.
26. Chrysobothris trinervia.
27. Elater nigrinus.
28. Corymbetes virens.
29. “ ochreipennis.
30. Celetes basalis.
31. Ellychnia corrusca.
32. Collops tricolor.
33. Leptura Canadensis.
34. Monohammus scutellatus.
35. Pogonocherus penicillatus.
36. Donacia pubicollis.
37. “ aequalis.
38. Adoxus vitis.
39. Lina interrupta.
40. “ scripta.
41. Galeruca sagittariæ.
42. Upis ceramboides.
43. Macrobasis unicolor.

VI.—From Thunder Bay to Lake-of-the-Woods, west of Lake Supe
Lat. 48° 25′, *Long.* 89° 10′, *to Lat.* 49° 25′, *Long.* 95° 00′.

1. Cicindela purpurea.
2. Bembidium picipes.
3. Platynus sinuatus.
4. “ sordens.
5. Pterostichus lucublandus.
6. “ patruelis.
7. Amara (Lirus) latior.
8. “ erratica.
9. “ interstitialis.
10. Bradycellus nigrinus.
11. Philhydrus perplexus.
12. Quedius lævigatus.
13. Silpha Surinamensis.
14. Ips quadriguttatus.

cinella picta.
odius fimetarius.
“ fœtidus.
chnia corrusca.
ynetes violaceus.
acia cuprea.
‘ flavipes.
ysomela Philadelphica.
oterus bivittatus.

)xford House, between Lake Winnipeg and Hudson's Bay. Lat. 54° 53′, Long. 95° 44′.

iophilus Hardyi.
phrus riparius.
abus palustris.
“ tædatus.
“ Chammissonis.
athus ingratus.
tynus sinuatus.
“ metallescens.
“ perforatus.
“ obsoletus.
“ quadripunctatus.
rostichus punctatissimus.
“ orinomum.
“ mandibularis.
nara (Lirus) cylindrica.
“ impuncticollis.
“ interstitialis.
rpalus pleuriticus.
mbidium impressum.
“ bimaculatum.
“ nitens.
“ nigripes.
“ axillare.
ydroporus alpinus.
tiscus confluens.
rinus ventralis.
chyporus jocosus.
eophilus maxillosus.
ophrum rotundicolle [Sahlberg].
rrhodites fenestralis.

31. Necrophorus vespilloides.
32. Silpha Lapponica.
33. Dermestes nubilus.
34. Attagenus megatoma.
35. Trogoderma inclusum ?
36. Pediacus fuscus.
37. Cryptophagus (not determined).
38. Anisosticta strigata.
39. Aphodius leopardus.
40. Dicerca tenebrosa.
41. " prolongata.
42. Buprestis Nuttalli.
43. " rusticorum.
44. Elater luctuosus.
45. Corymbites virens.
46. " spinosus.
47. " æripennis.
48. " metallicus.
49. Ellychnia corrusca.
50. Clerus undatulus.
51. Hadrobregmus foveatus.
52. Criocephalus agrestis.
53. Tetropium cinnamopterum.
54. Merium Proteus.
55. Hylotrupes ligneus.
56. Xylotrechus undulatus.
57. Rhagium lineatum.
58. Acmæops Proteus.
59. Leptura sexmaculata.
60. Monohammus scutellatus.
61. Pogonocerus penicillatus.
62. Gonioctena pallida.
63. Galeruca sagittariæ.
64. Graptodera (not determined).
65. Upis ceramboides.
66. Stenotrachelus arctatus.
67. Serropalpus striatus.
68. Hypomolyx pinicola.
69. Hylobius pales.

VIII.—Nelson River House, near Churchill River. Lat. 55° *Long.* 99° 30′.

1. Nebria Sahlbergi.

lophila rudis.
" Ulkei.
rabus palustris.
" tædatus.
" Chamissonis.
lathus ingratus.
tynus ruficornis.
" obsoletus.
rostichus orinomum.
iara (Stereocerus) similis.
' (Lirus) elongata.
' erratica.
' interstitialis.
' musculus.
rpalus pleuriticus.
tiscus confluens.
matopterus sculptilis.
bius confusus.
abus punctulatus.
rinus borealis.
crophorus vespilloides.
pha Lapponica.
rmestes lardarius.
podamia quinquesignata.
" tredecempunctata.
cinella trifasciata.
" quinquenotata.
atis quindecempunctata.
erca prolongata.
prestis Nuttalli.
anophila longipes.
ter nigrinus.
icosomus incongruus.
ymbites virens.
" resplendens.
" ochreipennis.
ychnia corrusca.
cephalus agrestis.
rium Proteus.
lotrechus undulatus.
hyta liturata.
nohammus scutellatus.
acia hirticollis.

43. Donacia cuprea.
44. Adoxus vitis.
45. Gonioctena rufipes.
46. Gastroidea cyanea.
47. Galeruca sagittariæ.
48. Upis ceramboides.
49. Meloe angusticollis.
50. Lepyrus gemellus.
51. Hypomolyx pinicola.

IX.—From Cross Lake, on the Nelson River, to Cumberland House o Saskatchewan. Lat. 54° 40′, *Long.* 98° 00′, *to Lat.* 54° 00′, *Long.* 102° 22′.

1. Notiophilus Sibiricus.
2. Carabus palustris.
3. Platynus cupreus.
4. Pterostichus orinomum.
5. Bembidium quadrimaculatum.
6. Gyrinus ventralis.
7. Pediacus fuscus.
8. Hippodamia tredecempunctata.
9. Buprestis Nuttalli.
10. Melanophila longipes.
11. Collops vittatus.
12. Merium Proteus.
13. Donacia magnifica.
14. " proxima.
15. " subtilis.
16. Cryptocephalus quadrimaculatus.
17. Galeruca sagittariæ.
18. Upis ceramboides.
19. Gonotropis gibbosus.

X.—From Cumberland House to Reindeer Lake. Lat. 54° 00′, 102° 22′ *to Lat.* 58° 30′, *Long.* 101° 00′.

1. Carabus tædatus (form Agassizii).
2. Platynus obsoletus.
3. Pterostichus orinomum.
4. Amara littoralis.
5. Cymindis cribricollis.
6. Thymalus fulgidus.

lanophila appendiculata.
noderus substriatus.
iocephalus agrestis.
rium Proteus.
nocallus collaris.
lotrechus undulatus.
mæops Proteus.
ptura sexmaculata.
“ nigrella.
nohammus scutellatus.
na interrupta var.
pomolyx pinicola.
lobius pales.

rom the north end of Reindeer Lake to the west end of Athabaska e. Lat. 58° 30′, *Long.* 101° 00′ *to Lat.* 58° 30′, *Long.* 101° 00′.

lathus ingratus.
atis 15-punctata.
rymbites ochreipennis.
dnocera humeralis.
nacia proxima.
“ subtilis.
is ceramboides.
rabus tædatus, var. Agassizii.

OLOGICAL SURVEY OF CANADA.
LFRED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR.

REPORT

ON THE GEOLOGY OF

RTHERN & EASTERN NEW BRUNSWICK

AND THE

RTH SIDE OF THE BAY OF CHALEURS.

BY

R. W. ELLS, M.A.

1881.

PUBLISHED BY AUTHORITY OF PARLIAMENT.

Montreal:
DAWSON BROTHERS.

1883.

FRED R. C. SELWYN, ESQ., LL.D., F.R.S., &c.,

Director Geological and Natural History Survey of Canada:

IR,—I beg to present herewith a report on the explorations and veys made, to the close of the season of 1881, in eastern and thern New Brunswick, and in the portion of the province of ebec bordering the Bay of Chaleurs, as far east as Cape Maquereau, Gaspé. Also a map, on the scale of four miles to one inch, of the ntry described in this report and in that of 1879-80, of which also ther details are now given.

Iy assistants during the past season were Mr. A. P. Low, a student the Faculty of Applied Science of McGill University, and Mr. T. D. ers.

Mr. Peers was engaged during the greater part of the season in king topographical surveys in Westmoreland county, to connect h those of Nova Scotia. The publication of the result of this work, l of that of other surveys made in the county of Kent, must be ferred pending further investigation required to complete the $\frac{1}{4}$-sheet ps, in which these areas, and a portion of the province of Prince ward Island, will be included.

In order to render this report uniform with those on New Brunswick eady published, the dips of strata are given with reference to the gnetic meridian, the variation of which for the Bay of Chaleurs y be generally stated to be N. $23\frac{1}{2}$° W.

I have the honor to be,
Sir,
Your obedient servant,
R. W. ELLS.

OTTAWA, 1st May, 1882.

REPORT

ON THE GEOLOGY OF

NORTHERN AND EASTERN NEW BRUNSWICK

AND THE

NORTH SIDE OF THE BAY OF CHALEURS.

BY

R. W. ELLS, M.A.

1881.

The present report refers chiefly to the areas included in the accom-
anying four ¼-sheet maps. These connect, about eight miles north
the latitude of Moncton, with those published in 1880, and corres-
ond with them in all details of coloring, scale, &c. Each ¼-sheet
presents 3,456 square miles. They are numbered as follows:—
—S.E., 2.—N.E., 3.—S.E., 3.—S.W.

Construction of map.

In the construction of the map we are much indebted to the several
ficers of the Crown Land Department, Fredericton, for valuable
sistance in supplying us with tracings of important rivers. The
ast line has been taken largely from Admiralty charts, corrected at
rious points by our own surveys. The Intercolonial and Kent
orthern lines of railway are from reductions of the official plans.
e roads in Kent, Gloucester and Restigouche counties, and along the
rth side of the Bay of Chaleurs, and various streams, are from
rveys by ourselves. In the county of Northumberland, only the
incipal roads, measurements of which were necessary for tie lines,
ere surveyed, the minor details of roads, streams, &c., being filled in
m the published county map by Roe and Colby, and from Crown
and plans.

Great difficulty was experienced in constructing the map of the
terior of the province, from its entirely unsettled and often unsur-
yed character, and here the want of accurate tie lines is to be

regretted. It is hoped, however, that from the material avail from outside sources, combined with our own surveys, the topogra cal and geological lines have been laid down with a fair degre accuracy, and that on the completion of the surveys now being car on in the western portion of the province by Mr. Broad, a ma New Brunswick embodying all the known geological and topogra cal features will be the result. This map will be of great value to Provincial Government; since the most favorable localities for se ment can be easily indicated on it, and the mistakes sometimes n in sending immigrants to sterile and unsuitable locations can be, great extent, avoided. The intimate relation between the geolog formations of the country and the agricultural character of its so every day more clearly recognized; and therefore a carefully structed geological map, rightly interpreted, is an approxima accurate index of the agricultural capabilities of the area it repres Through the recent action of the New Brunswick Governmen facilitating the construction of railroads, many parts of the cou now entirely useless from their inaccessibility will be opened up.

Value of map as an index to character of soil.

In all our explorations, careful attention has been paid to character of the soil in different localities. And it may be st that in New Brunswick the finest soils are, as a rule, found on Silurian or on the lower members of the Carboniferous syst The rich and fertile districts of Carleton and Victoria counties ma cited as belonging to the Silurian system, while the beautiful v of Sussex and the fine lands of King's and Albert counties r from the wear of strata which belong to the Lower Carboniferous mation. The soils formed from the Pre-Cambrian rocks, on the o hand, are generally hard, dry and stony, while the Middle boniferous (especially its grey sandstones), gives rise to a which is too light and sandy to be of much fertility, and wh when once exhausted, is with great difficulty restored to good co tion. Some portions of the Middle Carboniferous, however, consis of purple and reddish shales and sandstones, produce a soil of m greater strength and tenacity, often a stiff clay. This soil requ the addition of lime to make it easily and profitably worked. Silurian soils, as a rule, contain in themselves sufficient lime; they easily worked, and their fertility is very slowly exhausted. A kn ledge of the distribution of the formations referred to may, there prove of the greatest practical value to the immigrant and inten settler.

Character of soil dependent on underlying rock.

It is to be regretted that, for agricultural purposes, so large a por of the province should be occupied by the grey and sandy portio the Carboniferous system, and by granite and Pre-Cambrian crysta ocks. In such districts the principal areas fit for agriculture are ong the "intervals" or alluvial flats of the numerous streams, many f which are still uncultivated.

The systems described in the present report are—

G.—CARBONIFEROUS. { 2. MIDDLE. 1. LOWER.
F.—DEVONIAN.
E.—SILURIAN.
D.—CAMBRO-SILURIAN.
A B.—PRE-CAMBRIAN.

} With their associated igneous and crystalline rocks: granite, diorite, felsite, diabase, dolerite, &c.

G.—CARBONIFEROUS.

2. *Middle Carboniferous.*—The work of the past season, on this for-ation, was carried on principally in Kent and in the southern portion ' Northumberland counties. The general character of the rocks of e Middle Carboniferous were described in the Report of 1879-80. ıe examinations during the past season tend to confirm the supposi-on then advanced that the Middle Carboniferous of eastern New ·unswick is chiefly composed of the Millstone Grit formation, the Productive Coal Measures" being apparently wanting. Briefly ated, the geological structure of the eastern portion of the Car-niferous area, between the north side of the Bay of Chaleurs on e north and the head of the Bay of Fundy on the south, may be id to consist of four low, broad and shallow synclinal troughs, th their corresponding anticlines. Of these, the most northerly ncline is occupied principally by the waters of the Bay of Chaleurs, e southern margin or anticline being the high ridge that extends stward from the vicinity of Bartibog station on the Intercolonial ilway. The second syncline is occupied by the valley of the Mira-ichi River; the southern bounding anticlinal ridge, extending north-sterly from the head of Coal Creek in Queen's county on the west, aches the coast in the vicinity of Richibucto Head. The third syn-ne contains the valleys of the Buctouche and Cocagne Rivers, and is obably bounded to the south by the prolongation of the ridge of wer Carboniferous and Pre-Cambrian rocks seen in the Indian ountain and Irishtown settlements, a few miles north of Moncton. ıe fourth syncline is probably bounded by the ridge extending from e head of Cumberland Basin at Aulac to Bay Verte. Other subor-nate basins may exist, the evidences of which are not apparent.

Four principal synclinal basins in the Carboniferous of eastern New Brunswick.

The entire coast from Shippegan to Cape Tormentine is low and ersected by large estuaries, among which the principal are the

Character of coast.

Tracadie, Pokemouche, Tabusintac and Miramichi Rivers in Glouc
ter and Northumberland counties, and the Kouchibouguac, Kouc
bouguacis, Richibucto, Buctouche and Cocagne Rivers in Kent coun
In all these estuaries the tide flows inland from five to twenty mi
in a direct line; while if we take the distance from the outer bars
the Miramichi to the head of tide at Indiantown and Red Bank,
have nearly seventy miles of tidal water. Great sandbanks extend
an almost continuous chain along the entire eastern coast, traver
by gulleys or outlets for the water brought down the various strea
just mentioned, some of which are of large size.

Character of soil in Kent county.

The character of the soil on the areas occupied by the Middle C
boniferous rocks has already been described. (See page 2) T
sandy portions are of small value for agricultural purposes, but
heavy clay areas can be made of great fertility by the application
lime, which, especially along the shore of Northumberland Strait
now being supplied from the apparently inexhaustible beds of "mu
mud," composed largely of dead oyster shells. This mud is found
the estuaries of all the principal rivers, as well as at various poi
along the coast. When dug and exposed during winter, the sh
speedily become disintegrated by the action of frost and other cau
and afford a natural lime fertilizer, which, applied to stiff soils, p
duces wonderful results, while light, sandy soils are but little impro
by its application. Excellent ridges of farming land were observed
Kent county, where, among other localities, the valleys of the branc
of the Nicholas and of the Kouchibouguacis Rivers may be especia
mentioned. Large areas, however, are covered with sandy and pe
barrens, which abound with moose, caribou and bear, and supp
generally a scanty growth of scrubby spruce and pine, in marked c
trast with the beautiful groves of maple and birch which distingu
the ridges of reddish soil. None of these soils, however, possess
value of those of the Lower Carboniferous, probably from the abse
of lime in their composition.

Coal seam of Coal Branch, Richibucto River.

In my last year's report* (page 46 D) brief allusion was made to
occurrence of coal seams in this portion of the province. Since th
their various outcrops have been more particularly examined,
their probable economic value ascertained. The greatest thickness
coal observed was in the Coal Branch, a tributary of the Richibu
River, where at several points it shows a thickness of fifteen to eight
inches, and resembles very strongly in character and mode of occ
rence the seams on Coal Creek and Salmon River to the westwa
with which it is probably connected, or at least is their equival

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* Report of Progress, Geological Survey of Canada, 1879-80.

ht to the surface at this point by the gentle swell of the central
inal. The coal has been locally mined for several years to a
d extent, and, like that of Grand Lake, is well fitted for black-
work. It is, however, too soft and impure for a good house
and the thinness of the seam will probably preclude its being
l to any great extent. Among other outcrops, one on the Buc-
e River in Bishopland settlement was noted of ten inches, and
he Coal Branch station on the Intercolonial railway an extension
at first-mentioned is reported to have a thickness of eighteen
, but is probably exaggerated. On the Dungarvon, one of the
aries of the South-West Miramichi, an impure seam twelve
s thick was seen about twelve miles above the confluence of the
s River; on the main South-West, a few miles below Doak-
a seam from three to seven inches thick is said to exist. Other
as at Napan and Bay du Vin Rivers, reported to contain crops
l, were examined, and the coal found to be merely the carbonized
of probably drifted tree trunks imbedded in the grey sandstone.

Various coal outcrops in Kent and Northumberland counties.

s not at all improbable that all these outcrops may be portions
e and the same seam; the generally horizontal character of the
res would tend to give great lateral extension to the strata, and
place, except by faults, would the coal be carried to any great
; while the low anticlinals would bring the seam near the surface
ervals. But though it would be of much geological interest to
ain the thickness of the measures along the Gulf by boring, the
e indications do not point to the probable existence of deeper
icker beds of coal than those already discovered.

Probably no lower seam.

ings were made some years ago in Kent county for the purpose
aining oil, which was reported to occur at several points in
s. Examinations of these localities have led to the conclusion
these so-called oil springs were simply the ordinary mineral
s of the country, and that the oily appearance was due largely
presence of iron pyrites, which abounds in certain beds of the
r portion of the formation, and through decomposition often pro-
a thick, ferruginous scum on the surface of the water. This
e only substance having any resemblance to petroleum that we
ed in any part of this area in which oil springs are reported to
.

Boring for oil in Kent.

he portion of the province occupied by Carboniferous rocks, no
minerals other than coal are known to exist. Building and
stones are quarried at several places, some of the strata being
lly adapted for these purposes. The principal quarries are on
iramichi River and on the south side of the Bay of Chaleurs.

Grindstones.

stratigraphical position of the several coal seams observed may

Stratigraphical position of various outcrops.

be thus defined· The outcrops noted at Clifton and Shippegan belon to the most northerly, or Bay of Chaleurs, syncline; those of the Du garvon, South-West Miramichi and Coal Branch to the second, Miramichi, syncline; while the crops of the Buctouche and Cocag belong to the third. In the fourth or more southerly basin, a sma outcrop of coal from two to four inches thick is seen at Dupuis Corne about ten miles east of Shediac.

Permo-Carboniferous rocks of Cape Tormentine and vicinity.

The eastern portion of Cape Tormentine peninsula is bordered by narrow selvage of newer rocks, soft, reddish, micaceous sandston which resemble those seen on parts of Prince Edward Island. The extend from the vicinity of Cape Bald around the eastern end of Ca Tormentine and Jourimain, and up the Bay Verte for some six mil and rest upon the grey beds of the Millstone Grit which occupy t peninsula, but do not extend inland more than half or three-quart of a mile. Similar strata were also observed on the Nova Scotia sh near Tidnish Head. These rocks are very soft, and distinct in char ter from the ordinary purple and grey beds of the Middle Carbonifero and are probably newer or Permo-Carboniferous in age.

Hemlock forest.

The settlements along the Gulf of St. Lawrence are for the m part confined to a belt along the coast from five to twenty miles wi The disposition of the roads on either side of the several rivers in cates that the best settlement lands lie along their "intervals," the cr roads serving more for inter-communication than for settlement. T uplands of the interior often produce immense groves of hemlock a spruce. The trees grow to a large size, and are now specially valu for their bark, which is stripped, and the bare trunk left to rot in t woods. The destructive effects of this practice will doubtless be f before many years, especially in view of the rapid depletion of t more valuable kinds of timber which now form such an importa article of export, but which are rapidly becoming exhausted in ma localities, both from over-cutting and from the ravages of a small wo which has within the last two years begun to infest the spruce, a which rapidly works its destruction.

Destruction of timber.

Necessity for further examinations of the Lower Carboniferous.

1. *Lower Carboniferous.*—The additional work on this formation si the publication of the Report for 1879-80, has been principally alo the north side of the Bay of Chaleurs, in the province of Quebec. detailed geological examinations have been made in this area by t Geological Survey since 1844, and the discovery of the Devonian fi bearing beds of the Lower Restigouche rendered necessary a clo examination of this locality in order to more clearly define the dist bution of the Lower Carboniferous (Bonaventure) beds, and to asc tain the existence of further areas of Devonian rocks. According

e coast and the adjoining country to the north have been explored far east as the mouth of the Pabos River; and cross sections on the veral streams made for a distance of several miles inland.

The red sandstones and conglomerates which form the high bluff at e mouth of the Scaumenac River, opposite Dalhousie, mark the estern limit of the formation in this direction. They have a low, sterly dip, but are exposed for a distance of only a few hundred ırds. Thence to Pirate Cove the shore is occupied by the *débris* of evonian rocks. There, however, conglomerates crop out, which were first supposed to be a part of the Lower Carboniferous formation, ıt their distinct dip and high inclination, ranging from 55° to 90°, gether with their intimate interstratification with grey beds contain-g Psilophyton and other Devonian fossils, have now led to their paration. The upper beds re-appear, however, along the shore rther east, and form the bluff above Fleurant Point or in the vicinity Englishman's Brook, whence they extend eastward, and form the gh ridge already described in the previous report, where they uncon-rmably cap the red Devonian conglomerates just described, and also e sandy, grey, fish-bearing beds.

Distribution north of Restigouche harbor.

The unconformity of the two series is also well seen on the roads tending from the mouth of the Scaumenac to the Nouvelle, the p of the older being N. 30° E. < 65°–90°, while the newer or Lower arboniferous beds have generally low dips of 10°–25°. These newer d sandstones and conglomerates occupy the extremity of Point aguacha, and thence around to the mouth of the Nouvelle River, hile the harder and older series extends across in a direct line to the me point. Below the mouth of the Nouvelle to Carleton, Lower arboniferous beds are seen flanking the bold hills of Silurian slates or aps, and extend from the shore half a mile to a mile inland. Where posed on the back road leading up to St. Louis Mountain, they dip 40° W. < 25°–30°, but along the shore about two miles west of Carle-n a bluff of these rocks shows at one point an abrupt dip of 10° W. < 80°, changing, however, directly below to S. 10° E. < 20°, hence it subsides, and the shore thence to Carleton shows nearly orizontal beds extending out under the water and dipping slightly award. From Carleton they can be traced eastward by occasional itcrops and by the bright red color they impart to the soil, to the reat Cascapedia River, where they have an exposed breadth of about ur miles, with a southerly dip S. W. < 10°, and they probably under-e all this area along the shore, although, owing to the great pre-alence of *débris* and drift composed of Silurian and Devonian rocks, ith sands and gravels, but few ledges appear between Carleton and e mouth of the Great Cascapedia.

Unconformity of Devonian and Lower Carboniferous beds.

Point Maguacha to Great Cascapedia River.

Black Cape conglomerates.

Little Cascapedia River.

Between the Great and Little Cascapedia Rivers, exposures of ro
in the settled portion of the country are also very few. The shore
occupied by beds of sand, gravel and marine clays, but the general
red color of the soil, with an occasional outcrop of conglomerate alo
the back concession roads, which extend inland for a distance of thr
to four miles, indicate that the Lower Carboniferous formation h
here a breadth of nearly that extent. A small exposure of grey co
glomerate is, however, seen about one mile back from the shore on t
road leading north below Montgomery's mill, which serves to indica
the presence of Devonian rocks in this vicinity, and also the gene
thinness of the Lower Carboniferous formation. Between these t
last-named rivers, the Carboniferous rocks rest apparently upon str
of Devonian age, but westward to the mouth of the Nouvelle they a
seen at various points to lie against the flanks of the Silurian hi
overlapping the underlying Devonian beds. From the mouth
the Little Cascapedia eastward to Black Cape, the shore is oc
pied principally by Devonian and Silurian strata, but after pa
ing the Cape, which is a rough headland of dolerite, we find t
sets of conglomerates, both of which were in the Report for 18
classed as of Lower Carboniferous age. There is, however, a mark
difference in their character, composition and stratigraphical relatio
the underlying set being hard, dark brownish-red, and with
abundance of large pebbles of Silurian fossiliferous limestone a
trap of the vicinity, and having a dip of S. 50° W. < 60°, wh
the overlying beds are the ordinary soft red sandstones of Low
Carboniferous age, and dip S. 10° E. < 5°-10°. We have, the
fore, on these grounds separated them, classifying the former
Devonian, while the latter remains as formerly described. These t
sets of beds also appear on the Little Cascapedia; the overlying
Lower Carboniferous portion is seen in nearly horizontal beds ab
the mouth and for some distance—say a mile and a half—up stre
above which the banks for a mile or more are occupied by redd
clays, passing which, the second set of conglomerates is met wi
which will be described under the heading of Devonian.

Distribution eastward of Black Cape to Grand Pabos.

Returning to the shore east of Black Cape, the red beds of the f
mation under consideration are now seen extending eastward alo
the coast, without interruption, except by occasional banks of mar
clays and sands, to within two miles and a half of the entrance to P
Daniel Bay. At several points, however, as at New Carlisle, Shi
wake Point, Cape Loup Marin and eastward, the shore at low wat
and sometimes a few feet of the lower part of the cliffs, are seen to
composed of Silurian slates and calcareous beds, upon which the r
beds under discussion rest unconformably. As seen from the wat

he stratification of the Lower Carboniferous along this part of the oast is very nearly horizontal. At times a slight inclination of two to our degrees south-easterly is noted, but the beds are entirely undisurbed. East of Port Daniel to Grand Pabos post-office, the exposures f Lower Carboniferous rocks are very limited. A small area, with n exposed breadth on the shore of 150 paces, is seen on the east side f the harbor. At Herrington Cove, two miles below the eastern ntrance, another small exposure is seen in a depression in the cliff, nd a third near the contact of the Silurian and metamorphic rocks at ointe-aux-Bouleaux, about two miles west of Cape Macquereau. These arious exposures are in the Report of 1844 described under the head f upper conglomerates and sandstone; now, the siliceous conglomerate f the Bay of Chaleurs is known to be of Devonian age, and to be ssociated with the beds which yield Devonian fishes.

Distribution of formations on the Miramichi and its branches.

Lower Carboniferous strata were recognized on the Renous River, a ranch of the Main South-West Miramichi, where they have an exposed readth along the stream of two and a half to three miles; but on the ungarvon, a few miles farther south, they are not visible, the grey eds of the Millstone Grit overlapping them and resting directly upon he Cambro-Silurian of this locality. With this exception, they have ow been traced in a continuous belt from Bathurst south-westward to he St. John River, a few miles above Fredericton; their distribution n that area will be described in the report accompanying the map of hat locality in preparation by Mr. W. Broad.

F.—DEVONIAN.

Discovery of Devonian fishes at Campbellton.

During the past season, the extension of this system was further efined along the north side of the Bay of Chaleurs. The examination f the brecciated limestone and associated beds of Campbellton, which, s stated in the Report of 1879-80, probably marked the base of the ystem, resulted in the discovery of several Devonian forms hitherto nknown in Canada, among which were Cephalaspis, Coccosteus, &c., esides other remains. Immediately after their discovery, Mr. Foord, ssistant Palæontologist to the Survey, visited the locality and secured full and interesting collection. The following genera and species rom this collection, most of which are new, have since been identified nd described by Mr. Whiteaves in the *Canadian Naturalist*, Vol. X., No. 2.

Fishes.

Fossils from Campbellton.

Coccosteus Acadicus.
Cephalaspis Campbelltonensis.
Ctenacanthus latispinosus.
Homacanthus. Sp. undeterminable.

Crustacea.

Pterygotus. Sp. undeterminable.

Mollusca.

Cyclora valvatiformis.
Cyclora turbinata

Difference between the Campbellton and Scaumenac Bay beds.

The Devonian fauna and flora of the Campbellton area differ mar
edly from those of Scaumenac Bay, and indicate that, while the form
is characteristic of the lower portion of the system, the latter is clos
connected with the upper portion. During the past season, additio
collections have been made by Mr. Foord from the beds at Scaumen
Bay. From this locality the following genera and species have be
identified and described by Mr. Whiteaves:

Fossils from Scaumenac Bay.

Pterichthys Canadensis.
Diplacanthus.
Acanthodes.
Phaneropleuron curtum.
Eusthenopteron Foordi.
Glyptolepis microlepidotus? Agassiz.
Cheirolepis Canadensis. Sp. nov.

Measures wanting.

The gap in the continuity of succession of the various divisions
the Devonian system, thus indicated by the fauna and flora, is fu
confirmed by the apparent unconformity of the two sets of beds,
lower one being inclined at high angles, often vertical, and in pla
apparently overlaid by almost horizontal measures, the other app
ently undisturbed, and dipping at low angles of 7° to 15°.

Relations of the conglomerates to the psilophyton beds.

The red conglomerate beds of Pirate Cove, which, as already stat
resemble the beds of Lower Carboniferous age, were more clos
examined, and found to be Devonian. They were traced through
the Nouvelle River, and found to underlie unconformably the red,
beds of the Bonaventure series. They were also observed to be clos
connected and interstratified with the grey siliceous conglomerates
psilophyton beds so largely developed in this locality. Opposite
mouth of the Nouvelle, they were again seen on the post road, dippi
N. 10° E. $<$ 40°, the dip at Pirate Cove being N. 5° W. $<$ 80°. Th
are, however, directly succeeded and concealed by the Lower C
boniferous beds.

Between this point and the Great Cascapedia River, the typi
Devonian conglomerates and fish-bearing beds of Scaumenac Bay

Distribution between Scaumenac and Great Cascapedia River.

Fossils at Green Brook.

mpbellton were not noted; but lying on the flanks of the trappean
d Silurian hills, ledges of greyish quartzose sandstone are seen at
ervals, and may represent the Devonian system in this direction.
ese beds crop out on the road leading back to St. Louis Mountain,
ar the Shoolbred post-office, in a small exposure, associated with
p at the entrance of the gorge, resting on calcareous and slaty
urian rocks, dipping S. 40° E. < ? About three miles farther east,
a distance of 460 paces from the post road, showing reddish Lower
rboniferous soil, a low ridge of apparently altered quartzo-felspathic
ndstone is seen, separated by about 200 paces from the front of the
urian escarpment, which in this vicinity rises abruptly for nearly
)0 feet. These quartzose sandstones appear at intervals for several
les, but no fossils to indicate their exact age were found. East of
Carleton Mountain range, however, in the valley of Green Brook,
out two miles and a half north of Maria post-office, ledges of fos-
ferous grey sandstone of Devonian aspect occur, dipping S. 50°
< 60°: these apparently sweep around the western extremity
another great trap ridge which extends thence, with a break at the
sh Settlement road, to the Great Cascapedia River.

Devonian fossiliferous beds rest upon the trap hills.

In these sandstones and shales of Green Brook, crinoid stems, corals,
chiopod shells and psilophyton stems were observed. The beds
ve a different strike from the ordinary Silurian strata, and though
apparently associated with the typical grey Devonian conglomerates
the lower Restigouche, rest upon purple trap conglomerates, which
emble in character some of the beds lying at the base of this system
the vicinity of Campbellton and elsewhere. Farther east on the Irish
tlement road, and flanking the eastern spur of this trappean ridge,
ledges of reddish and greenish felspathic and grey ochreous sand-
nes of Devonian aspect, with reddish and grey conglomerates of the
al type, in which the dip was not discernible, but a short distance
th, beds of Silurian limestones and shale dips S. 10° W. < 65°, and
bably mark the southern limit of the Silurian in this direction.
e presumed Devonian beds just described doubtless mark the basal
mbers of the system as developed in this portion of the Bay of
aleurs.

The Devonian strata probably extend in an unbroken belt, under-
ng the Lower Carboniferous sediments, to the Great Cascapedia, as
y reappear again in considerable force on the eastern bank of that
eam, about four miles from its mouth, with a dip S. < 7°. These
ls may be traced up the river for several miles, where the lower
mbers, which consist of grey siliceous conglomerates, very closely
embling the beds of Fleurant Point, rest on calcareous and slaty
urian beds. No characteristic fossils were found here, but this is

probably due to the coarseness of the sediments, the finer shales be
apparently wanting, or at least not exposed to view.

Little Cascapedia River and eastward.

Between the two Cascapedias the surface is largely covered by d
though on the roads leading up the west bank of the Little Cascap
several small outcrops of Devonian rocks are seen, as well as along
back concession roads. They dip uniformly at a low angle southw
On this stream, in the vicinity of Brulé brook, hard dark-red conglo
rates dip S. < 2°—4°, and are probably the representatives of
Devonian in this direction, as they are intermediate in position betw
the calcareous slates of the Silurian farther up and the Lower
boniferous softer beds about the mouth of the stream. Farther
they are also associated with grey sandy beds holding psilophyton.
these localities the dip is low, not more than 7° to 10°, but on
eastern side of Black Cape, hard red Devonian conglomerates, alre
referred to under the section, Lower Carboniferous, are seen on
shore as well as along the Post roads in the vicinity, dipping on
shore S. 50° W. < 60° and on the roads S. 20° W. < 40°. The exp
breadth on the shore is about 600 yards, but on the road it is ne
three-fourths of a mile, and extends northward along the road lea
to the back concession for nearly a mile inland. East of this the r
of this system were not definitely recognized, although certain
underlying the Lower Carboniferous of the Bonaventure River
developed along the back roads to the west of that stream have a li
logical resemblance to the grey beds described. They contain,
ever, abundance of crinoid stems, and more probably are the eq
lents of the upper part of the Silurian. It has not yet been poss
owing to the difficulty of penetrating the interior, to ascertain
relations of the Devonian basin of the lower Restigouche and the u
part of the Bay of Chaleurs to that of Gaspé, but it is probable that
form two separate and distinct basins, with ridges of Silurian and c
rocks intervening.

Devonian basins of the Bay of Chaleurs and of Gaspé are probably not connected.

E.—SILURIAN.

The rocks of this system have their greatest development in
northern portion of New Brunswick and the central and sout
portion of the Gaspé peninsula. Their general distribution in
former province has been briefly described in the report of 187
but during the past season further explorations have been made i
province of Quebec, along the north side of the lower Restigou
and on the various rivers flowing into the Bay of Chaleurs.

Intrusive rocks north of Bathurst.

On the coast north of Bathurst, their bulk is much reduced by
presence of large areas of intrusive dolerite (diabase) and felsite, w
have burst through the rocks of this system in many places,

Character of country between the Bay of Chaleurs and the Upsalquitch River.

the Silurian beds to narrow wedge-shaped areas or patches by the trappean masses. It has, however, been found to be le to determine the exact distribution of these rocks, since the lying between the coast of the Bay of Chaleurs and the itch River to the west is densely wooded and entirely unoccu- ven the few portage roads that extend a short distance inland racticable, except in winter or during the driest weather. uch circumstances, the tracing out of the various Silurian nnot be accurately done at present, but from our observations psalquitch River, it is evident that the huge masses of trappean en near the coast do not, as a whole, extend across the entire to the river. Minor dykes and spurs, however, probably con- two localities, as these are seen cutting the Silurian slates on lquitch. The greater part of the surface is low, or, at least, oken by any elevation of considerable extent.

Extent of the Silurian, north of the Bay of Chaleurs.

north side of the Restigouche the Silurian system has a much and more extended development. After passing the trappean at form such prominent features from Campbellton almost to apedia River, the slates and limestones which form the bulk mation can be traversed across their strike for quite fifty miles, evident from the direction of the several beds on the opposite at they extend directly under the waters of the bay. They no point any very great elevation, but after ascending the t bold escarpment which fronts the shore they form a series ands from 1,000 to 1,200 feet high, frequently deeply furrowed umerous streams that intersect this portion of the province. the principal flowing southward are the Patapedia, Metapedia, ac, Nouvelle, Great and Little Cascapedias, Bonaventure, Pabos d Rivers. All of these, with the exception of the Pabos, have mined, and in all, the rocks of this system are well developed. ies as to the character of the country inland lead to the on that on the summit of these table lands, the soil is in many ell adapted for cultivation. It is to be feared however that, thern New Brunswick, their elevation is such that early frosts erially affect the successful carrying on of agricultural pursuits.

Contact of Silurian beds with the trap of Black Cape.

the north side of the bay, Silurian rocks do not appear on t from the western terminus of the trappean ridge below ia till we pass the mouth of the Little Cascapedia. Here, about one mile below the entrance of the river, they come ly upon the shore and form a cliff of moderate elevation for wo miles, or till they meet the intrusive traps of Black Cape. western exposure the rocks are limestones, hard and bluish, ain, with a dip of S. 55° E. < 40°, abundance of crinoids and corals. In a fourth of a mile the dip changes to S. 40° W. < evidence of the disturbing influence of the trap dykes in this vi being apparent in the partial altering of the limestone and the b or hardening of the sandy beds. In the next half mile the dips considerably, but thence on to Black Cape they dip regularly W. < 45. Small patches of these rocks are observable in the n trap at this point as though they had been caught in its upward Portions of these Silurian rocks are exceedingly rich in fossils, crinoids and brachiopods.

Black Cape to Cape Macquereau.

Below this to Shigawake Point, these rocks do not approa shore with the exception of a small exposure at the town site o Carlisle, where beds of red calcareo-arenaceous shale with a fe bands of limestone are seen occupying the lower portion of the front, as well as the main road leading inland from the centre town, on which at a distance of one mile from the post road th overlaid by Lower Carboniferous conglomerates dipping N. 15° E. the Silurian slates on the road having a dip of S. 50° E. < 5°. place also they are cut by numerous dykes of trap, dolerite or di which, spreading out, occupy a large portion of the town plot of C from the Catholic church east to the post office. At Shigawake about 400 paces below the mouth of the river, sandy shales wi careous beds come out in the lower part of a low bluff and exte 750 paces, having a dip of S. 20° E. < 60. At Cape Loup Marin beds appear, capped by Lower Carboniferous sediments, and extend almost without interruption to within two miles of Cap quereau or to Anse à la Vieille. At this point the contact Silurian with the metamorphic rocks of the cape can be well s the former dipping S. 30° W. < 35°, while the latter dip N. 30° E. 90°. A full description of the Silurian rocks along this portion coast is given in the Report by Sir William Logan, 1844, page the details of which it is unnecessary to repeat here.

Port Daniel.

At Port Daniel and vicinity they do not extend very far inlan the immediate neighborhood of the harbor, the most conspicuous bers of the system are shown in the great cliffs of encrinite lim which form the entrance. They are also seen to extend north-east two or more parallel ridges from the upper part of the bay, one, th northerly, keeping a few hundred yards to the east of the roa goes up along the side of the large lagoon; the strike of this ri north-east, the dip varying from S. to S.E. < 50°-90°. On th branch of the Port Daniel River the limestones are underlaid b of greenish-grey grits, dip S. < 60°, which resemble very close beds of the Nigadoo in New Brunswick, and which probably ma lower strata of the Silurian or the upper portion of the Cambro-Sil he distance of 1,500 paces farther up stream, ledges of dark grey black slates occur with a dip apparently unconformable to the erlying greenish grits just mentioned. These are doubtless the minous and graptolitic beds mentioned by Sir W. E. Logan as irring in the middle branch and mark the limit of the Silurian in direction. It is probable, however, that the grey and brown grits tioned as overlying the black slates may be, as stated, above the er beds of the Cambro-Silurian, in which case the black graptolitic es of the Port Daniel River would be the probable equivalents of graptolitic slates of the Tête à Gauche at the railroad bridge and rred to in the preceding report as of presumably Hudson River age.

Graptolitic slates of Port Daniel.

D.—CAMBRO-SILURIAN.

he rocks of this system in the Gaspé peninsula have in preceding s and reports been distinguished under the general heading of the bec group. During the past season the examinations of them e principally carried on in the vicinity of Cape Macquereau and ice eastward to Grand Pabos post office. In addition, a brief ex- ion was made on the Dungarvon and Renous Rivers, tributaries ie Main South-West Miramichi, where the breadth of this system ascertained and the eastern limit of the central granitic axis fixed. results of this exploration will be shown on the map sheets illus- ng the geology of the eastern portion of the province of New nswick.

Explorations over this system.

the vicinity of Cape Macquereau two sets of rocks are apparently loped, one of these has already been mentioned as occurring on streams that flow into the head of the Port Daniel lagoon and has referred to this system, as it evidently underlies the basal beds of Silurian seen there. The other set is much more highly meta- phic and in addition has a different strike. It will be described r the heading Pre-Cambrian, in which system it has been provi- ally placed.

Two sets of beds at Cape Macquereau.

he rocks which it is now proposed to classify as Cambro-Silurian been described by Sir Wm. Logan, report 1844. They do not appear he shore west of the Cape Macquereau lighthouse, but on the t to the east, about two miles from the end of the cape, a series of distinct to a large extent, both in lithological character and strati- hical position, from the more crystalline strata of the cape, are . In the vicinity of the Mahy Islands, where these Cambro-Silurian s are first well observed, they dip S. 20° E. $<$ 55° along the shore, dip on the Islands being more easterly, or E. 10° S. $<$ 40°. The amorphic rocks of the Cape, however, have a quite regular strike 7. 30° N., with dips of 75° to 90°.

Characters of the two sets distinct.

East from the Mahy Islands to Grand Pabos the rocks consist lar of felspathic slates, brown and ochreous, dark green, splintery s and shales with calcite, and brown and grey sandy schists. In addi thin beds of purple and grey slates are found, with green chloritic epidotic rocks. A few beds, slightly talcose, occur, but the great of these sediments seem to belong to a newer series, being much crystalline in character and much more sandy than the metamor rocks in the vicinity of the lighthouse.

The apparent want of conformity mentioned as occurring along shore is also evident on the East Branch of the Port Daniel R where the black slates and associated beds, though a good deal distu appear to strike almost at right angles to the felspathic gneisses w occur farther up the stream and which we have connected with crystalline felsites of the cape. They are therefore for these va reasons provisionally divided into two series, though the exposur this locality are not of sufficient extent to as yet warrant their plete separation.

Development on the branches of the South-West Miramichi.

In the province of New Brunswick, the explorations on this sy were confined to the Dungarvon and Renous Rivers, the latter a br of the Main South-West Miramichi. On the former the first exposur Cambro-Silurian were seen after passing the Carboniferous sandst about two miles below King Brook, a small branch from the so where hard green chloritic slates with softer bands occur, dip S. E. < 65°. These resemble the beds seen farther north on the Nig and elsewhere. Above this the band of black irony slates which f so marked a feature in this group, is met with, dip S. 20° E. < associated with green grits. Further up, above the mouth of the L Dungarvon, purple quartzites similar to those observed last year on Main South West were seen, and these continue up to the contact the granite near the mouth of McConnell Brook.

Above the Upper Falls on this stream the granites, which are o usual coarse red variety of the interior, are associated with band gneissoid rock; but the exposures are too limited to enable u separate the two series. Passing to the Renous River, rocks of system were first met with about a mile and a half below the m of the Little South Branch. Thence to the Upper Falls no granite seen in situ, although some granitic debris was observed on the por road up the river. It is not probable, however, that the granite pears in mass on the stream below the Upper Falls, but crosses a and sweeps round by the head of the river northward to the L South-West Miramichi.

The principal rocks of Cambro-Silurian age, on the Renous, are bl grey and purple slates, with softer gritty and slaty quartzose rock s upper part, dipping S. 25° E. < 60°, in which respect they resemble ıe beds seen on the Dungarvon to the south.

A. B.—PRE-CAMBRIAN.

The general distribution of this system has been given in preceding ·ports, and the only additional areas which are now classed under this ·ad are the rocks of Cape Macquereau and Port Daniel River. As ·veloped on the upper part of this stream, they consist principally of ırd rubbly felspathic and micaceous gneissic rock with quartzose icaceous, talcose and chloritic schists. They are, as already stated, ıite distinct lithologically and stratigraphically from the black slate Cambro-Silurian) series of the river; the strike of the latter being ıuth-west, while the older series strike north-west.

Cape Macquereau.

As first seen along the shore, about a mile and a half to two miles est of Cape Macquereau, these Pre-Cambrian rocks are directly overid by Silurian strata. They consist of hard dark reddish felspathic hist, including some thin bands of talcose schist. Some of the micaous schists hold disseminated grains of clear quartz. About the end the cape the rocks are hard grey quartzites with crystalline felathic and talco-chloritic schists. They have a strike N. 60° W. and p at angles of 75° to 90°, and they unconformably underlie the softer own and grey sandy beds seen along the coast farther east. As a ries they very closely resemble portions of the recognized Pre-Camian rocks of southern New Brunswick.

The evidence at present at our disposal, therefore, shows that a marked fference exists between the two groups that make up the area known the Quebec group at this point. The lowest portion, however, at d in the vicinity of Cape Macquereau, may not be older than the sal part of the Cambrian, but from resemblance to Pre-Cambrian beds New Brunswick and the lack of typical Cambrian such as is there cognized, it has been deemed best for the present at least to separate e older portion under the heading Pre-Cambrian, and it has therefore en provisionally assigned to that system.

ERUPTIVE AND IRRUPTIVE ROCKS.

Distribution north of Bay of Chaleurs.

The general distribution of these rocks in northern New Brunsck and about the lower Restigouche was given in last report. ıring the past season their distribution along the north side of the ıy of Chaleurs was more particularly noted. In this area the dolerites diabases extend in an apparently unbroken belt from their first outop about four miles below the mouth of the Metapedia to the Noulle near the upper bridge, where they are in contact with fossiliferous

Silurian strata. They form prominent features in the landscape, variou peaks rising from 1,000 to 1,700 feet above sea level. At the Nouvell they are cut off by the river, but almost immediately reappear on th eastern side, though in much diminished bulk, and extend along th north side of this stream to a point opposite its mouth, keeping at distance of one-fourth to a mile to the north. Another break occu here, but similar doleritic rocks appear again after an interval several miles, forming a ridge of about six miles in length, in whi the peak of Tracadigash, or Carleton Mountain, is the most promine point, having an elevation of some 1,700 feet.

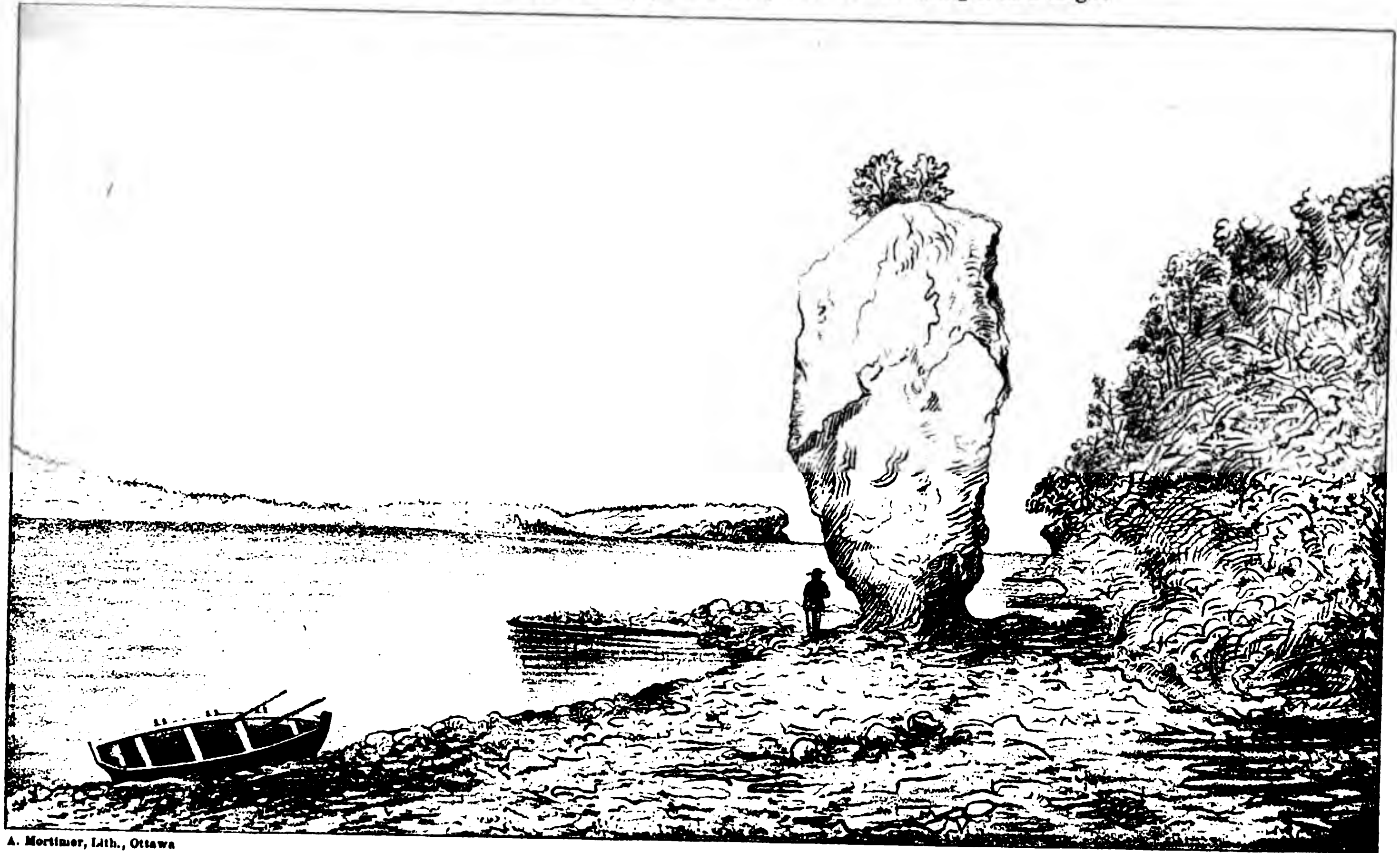
The valley of Green Brook makes another break here, after which t trappean hills rise again into a lofty ridge of about four miles in lengt and reach to within a short distance of the Irish settlement road. T most easterly spur of this range comes in on the road up the west si of the Cascapedia and extends to the river bank; to the eastward which, with the exception of Black Cape and the trap dykes of N Carlisle, these rocks have not been seen.

Relation of traps to the Silurian and Devonian rocks

The outline of these trappean hills is generally parallel to the sho The age of the igneous rock is very clearly defined by its str graphical relations to the Devonian and Silurian beds with which it in contact. Wherever found with the latter, it cuts them or occ as interbedded sheets, whereas the Devonian beds which are contact with it are, *as a rule,* not cut through or broken by it, although some of the lower members are highly inclin at detached points, but probably from other causes. Minor periods igneous activity have however occurred, during the deposition of Devonian, as is evidenced by the occurrence of occasional thin sheets trap along the bedding planes, as well as by that of beds trap conglomerates which are found closely associated with the low members of the system. The presence also of the Devonian fishes Campbellton, characteristic of the basal part of this system in brecciated rocks of that locality, shows that at this time there w disturbances of this nature. The upper part of the Devonian, howeve viz., the fish-bearing beds of Scaumenac Bay—shows no evidence igneous disturbance; but the basal beds of this portion frequently cont pebbles of trap in their conglomerates, while the beds dip generally low angles of 10°-20°. At Point à la Garde, also, the Devonian beds seen to form a low anticlinal over a spur from the trappean hills, basal beds of which consist of trap conglomerates, the pebbles be rounded masses of trap cemented by trappean matter, and at ot points these beds conform to the general outline of the various sp and depressions that exist along the north side of the lower Restigouc

At Black Cape also the trappean rocks are seen to have burst throu

This Pillar was destroyed twenty years ago by Men-of-War using it as a target.



A. Mortimer, Lith., Ottawa

Sketched in 1844 by Sir W. Logan. A. H. Foord, del.

PILLAR OF TRAP. *(Dolerite.)*

Bon Ami Cape. Bay of Ch

Black Cape.

lurian beds and hold pieces of the latter in their mass. The lower of the Devonian, on the other hand, in addition to large masses of ferous Silurian limestone, include fragments of trap and are thus ntly of later origin than the latter.

New Carlisle.

New Carlisle also the Silurian shales and calcareous bands are frequent dykes, generally of small size, which spread out and y a large portion of the town site. Here the Devonian beds are ng.

the New Brunswick side, the traps of the Bay of Chaleurs were rther traced south of Dalhousie, along the Benjamin, Louison, harlo Rivers. They were here found to have a breadth of from to ten miles, and to contain in places narrow wedge-shaped basins rian slates, limestones and conglomerates. The dark brown felonglomerate, described in report 1879-80, page 20D, is an apparwell stratified rock in places, and though frequently intersected interstratified with beds or dykes of trap, has been for the present d as of Silurian age.

western limit of these trappean masses towards the Upsalquitch ot yet been definitely determined owing to the impracticable cter of the country, and the connection of the large area on the o and Louison Rivers with the quite extensive outcrops seen on psalquitch above the forks of that stream has not been traced, untry intervening being generally low and swampy.

Area of trappean rocks about the upper part of the Bay of Chaleurs.

somewhat extensive development of the trappean rocks, as will en by the map, greatly reduces the breadth and area of the an beds, which strike across from the Upsalquitch to the Bay of urs. This reduction has been effected in places, probably by the g and crumpling of the various members of the Silurian in their ty, the evidences of which are visible in the frequent exposures the shore of the bay as well as on the Upsalquitch River, where folds occur at short intervals. The general breadth of the trapmasses on the lower Restigouche is from eight to ten miles. This with the breadth of the Charlo area, which is about the same, ne areas further south in the vicinity of Belledune and Elmtree, give a total width for these igneous rocks of not less than y-four miles.

Character of soil.

might be expected, the presence of such a bulk of rocks of this e has had a marked influence on the character of the country, the e of which is in general rough and the soil poor and scanty; and facts doubtless account for the sparsely settled condition of this n of the province. Where the surface is underlaid by the calus and argillaceous Silurian rocks, however, the soil is excellent ne settlements are therefore, as a rule, confined to such areas.

SURFACE GEOLOGY, SOIL, &c.

The general superficial features of much of the country to which tl
present report and accompanying map relate have already been d
Soil in Kent Co. scribed in former reports. It is not, therefore, deemed advisable
necessary to describe them here. In the area more particularly exa
ined last year, especially in the county of Kent and on the south side
the Bay of Chaleurs, rock exposures are not numerous. In the former ar
the surface is largely covered by sandy or clayey deposits, as the und
lying rock happens to be a grey sandstone or reddish shale. At seve
points, where the rock has been laid bare, glacial striæ are seen. The
near Weldford station, according to Mr. Dunn of that place, run no
and south. For the character of the soil see p. 4 D.

In the portion lying along the north side of the Bay of Chaleurs, dr
Marine clays of Bay of Chaleurs deposits are abundant. At many points high banks of well stratifi
gravels, sands and marine clays are seen, some of which, in the vicini
of Maria Capes, have a height of fifty to seventy feet. Farther dow
below the Cascapedia and the Bonaventure Rivers, the shores are oft
lined by marine clays of considerable thickness, holding abundance
shells of the usual types, already mentioned in former reports. Lo
deposits of shell marl exist in many of the lakes lying at the foot of t
hills back of the towns of New Carlisle and Paspebiac, (these are me
tioned in the Geological Survey Report, Logan, 1844,) as well as in beds
akes on back concession roads in New Richmond. In the Irish Sett
ment, west of the Cascapedia, several lakes occur, known locally as t
Blue Lakes. Blue Lakes, from their peculiar color. The blue tint is supposed by t
settlers in that vicinity to be due to some peculiarity of the wat
which, however, on examination, was found not to be the case, as it is s
gularly clear, but to the bottom of the lakes being occupied by a greyi
or bluish-grey marl or clay. The soil of much of this area is of exc
lent quality. It is underlaid by Lower Carboniferous and Silurian roc
The belt of level land is, however, narrow; the bold escarpment of t
Silurian and trappean hills rising at a distance of half a mile to thr
miles from the shore. Doubtless, much good land will be found on t
summit levels, which are said to be very extensive. In our explorati
of the Dungarvon and Renous Rivers several ridges of fine land we
crossed, lying on rocks of Cambro-Silurian age; and it may be gen
Fine ridges of land in Eastern New Brunswick ally stated that on this system between the Main South-West and t
North-West Miramichi Rivers a belt of country with a soil admiral
adapted for settlement exists. These ridges were met with betwe
the Bartholomew and Dungarvon Rivers in the vicinity of the porta
road from Doaktown; also between the Dungarvon and Renous; and
tween the two branches of the latter river, about the head of Monegh

Hard wood forests.

er north fine ridges were seen between the North-West the north branch of the Sevogle, as well as between the e latter stream. These ridges are generally covered owth of rock maple, yellow birch, beech and other hard large size. The soil is frequently a rich black loam, onsiderable depth and admirably suited for cultivation. about the heads of these streams, the country becomes he soil diminishes in depth and richness. At present, enerally inaccessible condition of this area renders it less, but upon the construction of roads along the valleys treams areas will be opened up which will doubtless be or settlement.

ECONOMIC MINERALS.

Middle Carboniferous of Eastern New Brunswick.

Probably Millstone Grit.

ugh indications of coal are found at various points, and been attempted at different times, the work so far has led with much success. During the past season examnade over a large part of the Carboniferous basin in the g seams of paying size, but so far without having our ; and it is to be feared that in the eastern as in the cenn portions of the Carboniferous basin, thicker and workal do not exist. It is probable that the great bulk of the iferous sediments of the province are confined to its or are of Millstone Grit age, which, while it sometimes able seams, as a rule does not yield coal in quantity suffireat economic value. The Carboniferous basin of New now been pretty thoroughly examined, and borings at have been made to determine the existence of lower ms, but without success.

Coal seams in Kent County.

utcrops to which reference has been made, the most exeastern portion of the province occur in Kent county. owever, do not exceed eighteen inches, which, considerquality, is not of sufficient size to be worked profitably. on the Coal Branch, a tributary of the Richibucto River, mill, and about six miles from the Coal Branch station, olonial railway. Other outcrops which may be of the seen at different points, the principal of which are deage 5 D.

Nigadoo and Elm Tree Rivers.

Galena.—The deposit mentioned on p. 45D, report of urring on the Nigadoo River, has since been opened to a epth, but has not as yet fulfilled the expectations of the the mine. An analysis of the ore has been made in the

Argentiferous galena.

laboratory of the Survey from samples that fairly represented its qua
ity, with a result of rather more than five ounces of silver to the to
This percentage may vary slightly either way. Another localit
since opened up is on the Elm Tree River, about four mil
from the mouth. The country rock at these localities is a har
metamorphic slate. The vein at the latter place is much bett
defined than on the Nigadoo, and has a width of from six to seve
feet, often breciated and porphyritic, carrying galena, blende, iro
pyrites and sulphuret of copper, associated with quartz and calcit
The rocks are a good deal broken up, and the metamorphism ma
be largely due to the local intrusions of trap rocks, which form suc
extensive ridges in this area. Sufficient work has not yet been do
to determine the actual value of the mine, a shaft having been b
lately started.

Analysis of silver ore.

As the strike of the rocks at the Nigadoo mine would run directly
the Elm Tree, it is possible that the two may be portions of one ve
much broken up, the character of the country rock being similar
well as the quality of the ore. These deposits occur in rocks very ne
the base of the Silurian system, possibly transition rocks betwe
the latter and the Cambro-Silurian. The locality on the Elm Tr
River is to be developed at the first opportunity, and, it is to be hope
with satisfactory results, as it is probable the opening of other simil
mines in this area will depend largely upon the success met with
this case. An analysis of the ore from the Elm Tree mine, made in t
laboratory of the Survey, gave a little over seven ounces of silver
the ton.

Gold quartz of Little South-West Miramichi.

Gold.—Nothing further has been discovered under this heading, wi
the exception that on one of the branches of the Miramichi a sma
piece of gold-bearing quartz is said to have been found fixed in the e
of a saw log which had come down the stream, in which case it mig
have been knocked off some one of the many quartz veins that inte
sect the slates and schists of the upper portions of these streams. T
locality is not definitely known, but it goes to establish the probab
occurrence of gold in small quantities in this portion of the provin
Persistent and long-continued search has, however, up to the prese
failed to find gold-bearing quartz veins, in so far as we have been ab
to ascertain.

Black Cape.

Apatite.—Apatite in quantity sufficient to be profitably worked w
reported to occur in the trap rocks of Black Cape, New Richmon
The locality was visited and specimens obtained, of which an ass
was made by Mr. Hoffmann. The result, however, was very unsatisfa
tory, the amount of tribasic phosphate of lime being only about t
half of one per cent.

'opper Ore.—Towards the close of the season a few days were spent
the examination of the ore deposits of Westmorland and Albert
nties. Of these the former is especially interesting, in view of its
urrence in Carboniferous sediments. The locality is about two miles
th of Dorchester, and the ore is found in the basal portion of the
lstone Grit, or very near its contact with the red marls of the Lower
boniferous. The ore is found both as carbonate, frequently ce-
nting the pebbles and filling the paste of the grey quartzose con-
nerate, which forms the base of the Millstone Grit, and also as grey
per ore or glance, which occurs apparently in pockets in the over-
ng or gritty beds. As might be expected, the carbonate appears to
nost plentiful in the vicinity of plant remains, the organic matter
vhich has undoubtedly precipitated the copper from solution. In
various openings which have been made for nearly two miles along
face of the escarpment that runs north from Dorchester Corners,
ore is seen in lenticular masses varying in thickness from a few
es to several feet, and should it prove to be continuous on the dip to
extent, would be of great value, as the quality of the ore is good
the mine very easy to work, both from the nature of the rock and
facilities for drainage. The rocks, sandstones and conglomerates
uniformly S. 5° 10° E. < 35. Active operations were commenced
his locality in the fall of 1881, but are now suspended. pending new
ngements by the company. The occurrence of copper ore in this
nation is quite common, but the quantity is generally too limited
e profitably worked.

Dorchester copper mine.

he only other deposit of copper ore known in this area is that seen
the Beech Hill road, about a mile and a half east of Memramcook
ner, where the ore is associated with purple fluor spar and baryta;
whole forming a vein of two to six feet wide, and extending for
eral hundred feet. The quantity of ore is very limited, and the
yta is too impure to be of any great economic value. Operations
ied on formerly at this locality have long since been abandoned.

Memramcook copper and baryta mine.

second deposit of copper ore was examined in Albert county. It
urs on a small branch of the Upper Salmon River, about two miles
t of the road leading from Hillside P. O. to the New Ireland road,
about eight miles south of Elgin Corner. The location is known
lly as the Goodfellow Mine, and consists of a vein which is tolerably
l defined, carrying copper sulphuret with a little peacock ore and
oonate, with iron pyrites in a quartz and calcite gangue, mostly the
er, and situated in the talco felspathic and chloritic schist of Pre-
nbrian age. The breadth of the lead is from fifteen to twenty-five
, and it has a direction nearly east and west. The quantity of
phuret of copper in some portions is considerable, but sufficient work

Albert County copper mine.

has not yet been done to determine its true value. Another deposi similar in character, in rock of the same kind occurs on the head wate of the Coverdale, about five miles north-easterly, but this also has n been sufficiently opened to ascertain its value.

EOLOGICAL SURVEY OF CANADA.

ALFRED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR.

REPORT
ON THE
GEOLOGICAL FORMATIONS
IN THE
GASPE PENINSULA

1882

BY

R. W. ELLS, M.A.

PUBLISHED BY AUTHORITY OF PARLIAMENT.

Montreal:
DAWSON BROTHERS.
1883

LFRED R. C. SELWYN, ESQ., LL.D., F.R.S., &c.,
Director of the Geological and Natural History Survey.

R,

The accompanying report on the Geology of the Gaspé peninsula, continuation of the work of the past season, is herewith subitted. The examinations were for the most part confined to the cinity of the coast, but several excursions inland were also made, incipally on the Rivers flowing into Gaspé Bay. My assistants during e past season were Messrs. A. P. Low, T. D. Peers and H. P. Brumell, e two former of whom had been with me during the previous year. addition to the geological investigations, a large amount of topoaphical work was done, including a chained survey of the post road om Little Pabos to Gaspé Basin and thence along the south shore of e River St. Lawrence to Grand Metis, whence connections were made ith the Intercolonial railway at Little Metis and Sayabec stations. ne back concession roads and others connecting with the shore, as so the entire coast-line were measured by pacing and the various rock posures carefully examined.

Our thanks are especially due to Mr. Joseph Eden, Harbor Master of aspé, to Messrs. J. and E. Collas, and to H. Bouthillier, Esq., for rious favors.

Many new facts were obtained in regard to the distribution of the veral formations, more especially affecting the Lower Carboniferous d Devonian, and the relations of the various members of the so-called uebec group, to which particular attention was directed, have been, e trust, more clearly defined.

I have the honor to be,
Sir,
Your obedient servant,
R. W. ELLS.

Ottawa, May, 1883.

REPORT

ON THE GEOLOGY OF THE

ASPE PENINSULA,

1882.

BY

R. W. ELLS, M.A.

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al systems and formations described in this report

NIFEROUS.	1. LOWER.	(Bonaventure.)
IAN.		(Gaspé sandstone series.)
AN.		(Gaspé limestone series.)
O-SILURIAN.		(Quebec group.)
IAN.		
JS ROCKS.		

G.—CARBONIFEROUS.

Distribution of Lower Carboniferous rocks.

rboniferous.—In the report for last year it was stated of the Quebec group (Cambrian and Cambro-Silurian) at a distance of a mile and a half east of Grand ust west of the Grand Pabos, P. Q. At this place boniferous beds, which have been wanting for about s, are again developed in considerable force, and ly horizontal, soft, red sandstones and conglomerates pe. These extend eastward, and at the Little Pabos readth of about two miles and a half, resting upon urian slates and limestones. Thence they cross the a continuous area along the shore to near the Grand n the road up the west side, at a distance of three-ile from the mouth, they are again seen to overlap e Silurian strata then occupy both banks and form cliffs of considerable height. Between the Grand River and Breche â Ma Brook, another Carboniferous area of small extent is found, the Silu strata coming out to the shore again at the latter stream; but from Bre â Manon eastward the rocks under consideration extend uninterrupt to White Head at the west side of Percé Harbor. The northern bou ary cannot be traced continuously, but at various places on the b concession road, the junction with the Silurian, and further east the Devonian on the Branpits Brook and at other points between brook and Percé village, can be easily perceived, and clearly indic that inland the Lower Carboniferous has a very limited developm

Unconformable junction with Silurian and Devonian.

At several points along this part of the coast it is seen to rest un formably upon the Silurian or Devonian strata, which occupy the b and form the lower part of the cliffs. Notable examples of this o in the vicinity of Breche â Manon and at White Head, at which la place slates and limestones come out to the shore and occupy the en headland for several hundred yards. East of this point another s patch of these rocks rests upon Devonian strata and extends back f the shore for about half a mile, but a larger and much more impor area is that of the Percé Mountain, where the red sandstone and glomerates described by Sir W. E. Logan (Report, 1844) are see constitute the upper part of that elevation and to rest upon anothe of conglomerates somewhat similar in character, but unconformab position, and presumably belonging to a lower horizon.

Mal Bay and Grand Briant Brook.

The only other deposit of this age, observed by us on the mainl is found on the north side of Mal Bay, extending for a distance mile and a half up the Mal Bay River, where, as at Percé, they seen to rest unconformably upon Devonian beds. The same rela position is seen to the east, at Grand Briant Brook, where the lo beds terminate. They extend about one mile and a quarter inl where they rest upon reddish beds, presumably of the Gaspé sands series.

The surface of Bonaventure Island, three miles southeast of Perc also occupied by Lower Carboniferous rocks, and the name given to formation by Sir W. Logan, was derived from it. In the cliffs at northeast end of the island, conglomerates are seen like those w form the base of Percé Mountain. They are undoubtedly conne with these beneath the intervening water, and they hold a sim unconformable relation to the beds which rest on them.

Changes in the distribution as described 1866.

It will be seen from the foregoing and by reference to the Geolog Map (1866), that important changes have been made in the descr distribution of the Lower Carboniferous of this area. These cha have been based on lithological and stratigraphical evidence, w shews that much of the conglomerate formerly styled Bonavent lies unconformably the typical Bonaventure beds, while in its osition it exactly resembles the Devonian conglomerate of the part of the Bay of Chaleurs, which was also formerly regarded this age, but which is now, from the discovery of distinctive nian fossils in interstratified beds, plainly recognized as belonging ower horizon.

characteristics of the rocks of the Bonaventure formation have fully described in former reports, and the changes referred to in stribution will be shown on the maps now being prepared.

F.—DEVONIAN.

The Gaspé series as described in former reports.

ormer reports of the Geological Survey, on the Gaspé peninsula -1857 and 1863), the rocks which we now propose to discuss the head of Devonian, were described as the Gaspé series, and d into two groups, the Gaspé sandstones and the Gaspé lime- ; the former of which were considered to be of Devonian age, the latter were assigned to the horizon of the Lower Helderberg. vident, however, that a portion of the latter can, on palæontologi- ounds, be now included in the Devonian also (see Vol. II., Part l. Fossils), while, in the upper part of the system, we propose to e a considerable thickness of conglomerates, which in former were regarded as a part of the Bonaventure or Lower Carboni- formation. The reasons for this change are founded, as already on both lithological and stratigraphical evidence.

most easterly exposures of Devonian rocks described in my last (1881), are in the vicinity of Black Cape, New Richmond. this point, if they exist at all along the north side of the Bay of ırs, they are concealed from view by the nearly horizontal beds Lower Carboniferous. A small outcrop of sandstone and con- rates of Devonian aspect was, however, noted by Mr. Lord, on naventure River, as occurring between the Lower Carboniferous lurian rocks, which would tend to shew that, for a part of the e at least, Devonian sediments had been deposited in this on.

Upper beds of the Devonian rear of Cape Cove.

ve approach Percé, we find on the back concession road, in rear e Cove, in the beds of several of the brooks which have cut ls of considerable depth, ledges of hard grey and brown quartz- dstone in a nearly horizontal position, which doubtless belong upper portion of this system, and it is very probable that in the Percé and about the heads of the streams which flow into Mal ese rocks have a considerable development, the newer measures confined to a narrow strip of from one to two miles in width he shore.

Two sets of Conglomerates different in aspect.

In the Irishtown settlement, about two miles and a half west of t junction of the back concession road with the post road, near the villa of Percé, the Devonian rocks are seen to approach nearer the coa High hills of conglomerate, with beds of hard grey and brown sa stone, are observed in close contact with the soft red beds of the C boniferous, while the numerous springs which are seen to issue fr the side of the hill for a distance of over a mile along the road, indic the line of junction between the two formations. The marked diff ence also in the aspect of the two sets of beds, serves easily to defi them. The older conglomerates are the same as those which form t basal portion of Percé Mountain, and those about the upper part of t Barachois of Mal Bay, and which underlie the Bonaventure, develop about the mouth of that River and along the coast to Grand Bri Brook, and have been already briefly alluded to in our remarks on t Lower Carboniferous.

Percé Mountain.

On the road from Percé to Mal Bay, which passes over the west spur of the mountain, the rocks of this system are seen in considera variety. The conglomerates just described, which we have n assigned to its upper portion, are continuously exposed to the po where the road suddenly turns down the northern flank, and the l of contact or overlap of the Bonaventure, is seen about two hund yards to the right, in a depression down which flows a small brook Percé Harbor. At the highest part of the road, large ledges contain abundance of limestone pebbles, which hold fossils of Silurian age, N. 55°. E. <30°. Descending the mountain to the north, outcrops grey fossiliferous limestone and shale are noted, which are proba the continuation under the mountain of the beds seen at Mount J presently to be described. Further north, towards Mal Bay, the r is strewed for some distance with blocks of grey Devonian sandsto and grey and black sandy shales, which belong to the first b seen on the shore section south of Mal Bay beach, and which unc formably overlie the calcareous slates, limestones and sandstones Percé rock and the Blowhole cliffs. The last exposures seen on road to the south of the beach, are fine reddish brown conglomerat which dip N. 20°. E. < 80°.

Three series of Devonian strata.

It would appear, therefore, that in this limited area we have three s of Devonian strata exposed: the upper, consisting principally of c glomerates, with interstratified beds of sandstone; the middle, of sa stones and shales, with some conglomerate beds; and a lower, larg calcareous, and containing considerable beds of limestone. The r tions of these we will now consider.

Crossing the Barachois of Mal Bay, we find a considerable area conglomerates, developed along its north side and extending eastw eter, a portion of which have already been described l of Lower Carboniferous. The lower beds first come he road up the north side of the Mal Bay River, about half west of the ferry, and consist of hard brownish- conglomerates and sandstones, the former containing ebbles of limestone, jasper, white and yellow quartz and are undoubtedly the equivalents of those which form t of the Percé Mountain, towards which they dip in a °–75°. E. < 5°–10°. These in turn overlie the sand- les of the Gaspé series proper, which are developed on r for several miles, and form a basin of considerable ed on the south by the Percé anticlinal. Eastward, St. Peter, these rocks are first met in a small cove, just the road strikes across the peninsula to Anse à Brillaut, ontinue to the end of the Point, and occupy its entire r west as Point Jaune on the north shore. These beds in the Report of 1844, under the head of Limestone and a detailed section is given in the appendix to that 82, in which the thickness, as exhibited along the coast, 6 feet.

Estimated thickness in the report of 1844.

en by reference to this section, that a marked similarity of the beds which constitute the upper portion of the ne series, though the latter lacks the heavy beds of which form an important feature of the series under

e strata, on the north side of Point St. Peter, is constant eing S. 85°. E. < 10°–20°.; and at its extremity they nall island lying half a mile distant, and which probably tact with the Bonaventure formation. If we suppose the the mainland and this island to be occupied by the con- ler discussion, we may add a further thickness of 250 to t already given for the shore section. This would give nember of the Devonian, an entire thickness of about veral faults, however, of greater or less extent, render rements very difficult.

Thickness of the upper members of the Devonian.

ortion of the Devonian, known here as the Gaspé sandstone uch greater development, and comprises the bulk of the ch belong to this system. It is distinct in lithological n the series just described, in having a great preponder- ndstones and shales, as well as an abundance of contained The descriptions of the various members of the series e Geology of Canada, 1863 (pp. 394–96), and elaborate detailed measurements, are contained in the Report of Pro-

Faults.

gress for 1844. From these, their entire thickness is estimated at 7,036 feet. They occupy the whole area of Gaspé Bay, from the contact with the limestone series, on the north side, at Little Gaspé, to the overlap of the upper conglomerates at Point Jaune, on the south shore, about two miles and a half west of Point St. Peter. Here the two series are brought into contact by a fault, the extent of which cannot be accurately estimated, but judging from the character of the beds on either side, it cannot be very great.

Most southerly exposures of the Gaspé. sandstones.

The most southerly exposures of the Gaspé sandstones are seen on the coast between Percé and Mal Bay. About half way between these two points, grey and brown sandstones, fine conglomerates and soft red and grey shales, the coarser beds containing abundance of plant stems, often of large size, with the bark turned to coal, are seen in unconformable contact with grey calcareous shales and limestones of a lower series, on the one hand, and with the hard, dark red conglomerates just described, on the other. These are undoubtedly the equivalents of the upper part of this series, as seen on the south side of Gaspé Bay, and have a quite regular dip of N. 20°–30°. E. < 60°–70°. An anticlinal structure is evident along this part of the coast, by which the lower or Gaspé limestone series is brought to the surface, since on the post-road, a short distance inland, grey shales and limestones are seen to dip S. 25° W. < 40°. The exposures of the sandstones and associated beds terminate on the shore just before reaching the Mal Bay River, about three miles from its mouth; the intervening area being occupied by the alluvial island and the waters of the Barachois.

Four basins with intervening anticlinals.

The rocks of the series have a considerable development on the several rivers that flow into Gaspé Bay, where they lie in shallow basins, bounded by the anticlinals, which bring into view the strata of the lower or Gaspé limestone series. These basins are at least four in number, the dividing anticlinals being known as the Hildemand, the Tar Point, the Point St. Peter, and the Percé, the most southerly yet recognized. On the south side they rest upon rocks of the Silurian system. The whole formation may therefore be said to occupy a geosynclinal basin the western limit of which has not yet been traced, but which will probably be found to be continuous with the basin recognized on the Cascapedia River and thence extending to the Metapedia. Further explorations about the head waters of the York and Bonaventure Rivers will be necessary to determine this point.

Fossil plants.

As already stated, this series is distinguished from the lower by the abundance of plant remains, among which, from various places around Gaspé Bay, the following have been determined by Dr. J. W. Dawson:—

Prototaxites Logani.
Lepidodendron Gaspeanum.

Lepidophloios antiquus.
Leptophleum rhombicum.
Psilophyton princeps.
" *robustius.*
" *elegans.*
" *glabrum.*
Nematoxylon crassum.
" *tenue.*
Stigmaria areolata.
" *minutissima.*
Didymophyllum reniforme.
Calamites inornatus.
Annularia laxa.
Arthrostigma gracile.
Cyclostigma densifolium.
Cordaites angustifolia.

Descriptions in the Geology of Canada, 1863.

Such full descriptions of this formation have already been given in the Geology of Canada, 1863, pp. 394 to 404, and pp. 880-86, as well as in other earlier reports, that further descriptions here are considered unnecessary.

Gaspé limestone series.

The lower division of the Gaspé rocks in the reports previous to 1872 was styled the Gaspé limestone series and assigned to the horizon of the Lower Helderberg or upper part of the Silurian system. In Vol. II., Part I., Palæozoic Fossils, however, published in that year, the strata which composed the series were divided into eight parts, the entire thickness being estimated at 2,010 feet, of which the two lower members, representing a thickness of 160 feet, were stated to be probably Silurian, while the two upper members, aggregating 800 feet, were Devonian about the horizon of the Oriskany. The remainder, or 1,050 feet, were considered to constitute transition beds. During the past season, however, a considerable collection of fossils was made on the upper part of the Griffin Cove River, at the peaks of the Ruisseau de la grand Carrière and for a short distance below. The strata here are very near the contact with the rocks of the Quebec group, and the fossils are from the lower division of the limestone series. Among them Mr. Ami, of the Palæontological department of the Survey, has recognized:—

Zaphrentis cingulosa.
Strophomena punctulifera.
" *inequiradiata.*
" *perplana.*
Orthis aurelia (?).

Atrypa reticularis.
Athyris (*Merista*) *arcuata.*
Lingula Lucretia.
Spirifera cycloptera.
Pleronitella (allied to *P. venusta*).
Orthoceras. Sp. undet.
Illoenus (*pygidium*).
Dalmanites Anchiops.

Exposure near Percé.

The first exposures of the rocks of this series are found in the vicinity of Percé. They probably constitute White Head, to the west of Percé Harbor, where they unconformably underlie both the Lower Carboniferous and the Upper Devonian conglomerates, though the paucity of organic remains leaves the exact age of the strata at this point somewhat uncertain. But at Mount Joli and along the shore north, for some distance, they are well seen in the high cliffs that form the Murailles and Barry Cape. They also form the detached mass known as Percé Rock. Inland they were recognized on the post road to Mal Bay, after descending the Mountain. In places along this part of the coast these strata are brought into view through the wearing away by the action of the sea, of the overlying sandstone series just described. The rocks thus exposed consist of grey calcareous shales, slates and sandstones, with bands of hard quartzose rock and reddish and grey limestones, the latter often veined with calcite. Though much disturbed in places, these strata have generally nearly vertical positions. They dip on the seaward side N. 20° E. < 60°-90°, and along the road S. 25° W. < 40°, showing clearly the presence of an anticlinal by which these lower strata are brought into view. This anticline is also well marked at several points along the coast, as well as at Mount Joli, where its extension carries it seaward to Percé Rock, separated from the mainland by several hundred yards. This rock received its name from the fact of its being pierced or perforated by two holes, doubtless worn in the strata by the restless surge which comes in with terrific force at this place during an easterly gale. The arch of the outer wall fell in 1847.

Anticlinal axis.

Percé Rock and the Blow-hole.

The Rock consists principally of hard brownish-red limestone with some shales and fine conglomerates in a nearly vertical position, and resembling in character the beds seen along the coast towards the great Blow-hole. They abound in fossils, brachiopods, tribolites, &c., in a collection of which the following species have been recognized :—

Strophomena Blainvillei.
" *Tullia.*
Zaphrentis cingulosa.

hrentis corticata.
netes Canadensis.
" *Dawsoni.*
" *Antiopa.*
his musculosa.
rifera cycloptera.
" *Gaspensis.*
tyostoma ventricosum.
tyceras tortuosum.
dontopsis ventricosa.
tocoelia flabellites.
hoceras, sp. undet.
lmanites Anchiops.

Fossils from Split Rock.

nens were collected mostly from the Split (Percé) Rock shore adjacent, but from the coast two miles north or cliff known as the Blowhole a few fossils were also g which were recognized :—

rifera arenosa.
" *cycloptera.*

parison of the forms found at Percé, with those described Cove River the parallelism of the beds at the two locali-. It will also be observed that most of the species are an, and belong to the lower portion or probably the of the Oriskany formation.

Cape Gaspé and Ship Head.

between Mal Bay and the north side of Gaspé Bay no similar to those under consideration, but on the several g into this portion of the gulf they have been recog-ought up by the various anticlinals already mentioned. development, however, is on the north side of Gaspé ey form the bold headlands of Cape Gaspé and Ship ower 600 to 700 feet perpendicular above the tide, form-nity of the cove finger-like projection which extends Rosier Bay. They are seen in contact with the upper es at Little Gaspé as well as in the Dartmouth River to e there appears to be a gradual passage of the beds of the lower portion. Further west they have been recognized n River south of the great bend at the Terrace Mountains. oreadth in the road leading across to Griffin Cove is one f. By the extension of the Tar Point anticlinal west-ocks can be traced to the southern slope of the Shick-here their development needs to be further studied.

iclinals mentioned as existing in the Gaspé Devonian

Extent of the four anticlinals.

Tar Point trap dyke.

basin were traced for a great portion of their extension from the cc
to the upper waters of the Dartmouth and Douglastown Rivers by
Bell, and their positions are described in the Geology of Canada, 1
(p.p. 406-410 and 88-86). No new facts were obtained on the sub
except that the fourth or Percé anticlinal was more exactly defined
there appears very little doubt it is the same as that observed to c
tinue along the valley of the Douglastown River. There is also
dently a break in the continuity of the Tar Point anticlinal whe
crosses the Douglastown River. Since all the strata in that str
from the crossing of the Point St. Peter anticlinal at the bend, t
teen miles from the mouth, to the head of the Barachois, dip unifor
north-easterly, the last recorded at the head of the island being N
E.<20°. It therefore evidently dies out in the distance between
river and the York, yet is brought prominently into view again on
coast at Tar Point by the extension of the trap dyke at that localit

Contact of sandstones and conglomerates at Point Jaune.

In regard to the eastern termination of the Point St. Peter anticl
some doubt exists. The conglomerates which form the extren
appear to have an anticlinal structure, but the lower members of
system in the sandstone series proper do not come into view at
place. The crest of the anticlinal has, therefore, probably s
below the sea level some distance before reaching the coast. A m
marked anticlinal structure is apparent in the upper part of the sa
stone series about two miles and a half north of Point Jaune, wh
latter place marks the contact of the sandstones and conglomerates,
opposing dips of which are S.70°E. and N.20°E., the angles, howe
being low, not more than 5° to 10°. This, therefore, may only b
local disturbance, and was evidently so regarded by Sir W. Logai
his examination of this part of the coast, as he includes all this str
in his séction. The Portage road across the peninsula from Mal
to Anse â Brilliant shows but few ledges, but at one point about
miles from the southern extremity of the road red sandy shales v
grey Devonian sandstone were observed to dip S.25°-30°E.<5. Tl
beds evidently extend underneath the conglomerates that cap
extremity of the point, and tends to support the opinion that the
of this anticlinal follows the line of the Point St. Peter peninsula
reaches the coast near its end.

Survey of St. John and Douglastown River.

In order to complete if possible the survey of the St. John
Douglastown River, which had already been measured by Mr. Mu
in 1845 as far as the forks, a distance by the river of forty-eight m
or in a direct line from its mouth thirty-eight miles. An excur
was made to that point. It was found, however, after reaching
fork, that owing to the low state of the water, and the impossibilit
traversing the wilderness without a larger force of men, further

lirection was impossible. Above this point Mr. Murray
1845-46, p. 107-8) "the valley takes a north-west direc-
informed by the Indians who were acquainted with the
he river branches off into several small streams at a
ee or four miles above the point we reached, ultimately
nong the mountains near the sources of the Bonaventure
Rivers of Gaspé (York). Where we stopped the river
of sixty feet, but increasing in its downward course pro-
ith the supply from its tributaries, it was at a short
the jam (near its mouth) upwards of 300 feet across.
fall in the whole measured distance was thirteen feet
eight of the highest point being 643 feet above the sea

Tributaries of the St. John River.

ır considerable tributaries to the St. John, two joining
first seven miles from the mouth, the other two at the
ances of thirty-nine and a quarter and forty-six and a
from the entrance, and all coming from the south, besides
ones falling in on either side. The two upper forks are
ake their rise very near the upper N. E. branch of the
and the lower of the two sweeps past the western base
known by the Indians as Mt. Alexander, and one of the
ed in our triangulation from Mr. Albert.

part of the river for a distance of thirteen miles flows
l country, producing white pine, spruce, and a species of
ly of considerable size and of valuable quality, balsam,
three varieties of birch, white maple, elm and ash in
.

this flat country is bounded by a range of hills, which,
t the sea coast near Mal Bay, run in a north-west direc-
ually approaching the river strikes it thirteen miles from

Level country fit for cultivation.

the north side of the river the country continues to
level character across to the south-west on River York,
to be covered with a good soil of sandy loam, it is doubt-
ied to be brought into a state of cultivation, and might
ne as valuable an agricultural tract as any in the penin-

f the upper part of the stream flows through a moun-
. In some places extensive alluvial flats occur between
he mountains, while at others the valley contracts to a
orge, the hills rising precipitously from either bank to a
nally of 300 to 400 feet. The hills increase in elevation
t of the stream, and the highest one ascended measured

Mount Alexander.

845* feet above the level of the sea. From the hill directly above the point where our survey terminated Mount Alexander bears due south. From its long and straight roof-like top, as well as superior elevation, it was easily distinguished as one of the most conspicuous points seen in our eastern horizon from Mount Albert.

The upper part of this stream, from the Forks to a point about thirteen miles from its mouth, runs on the strike of the Gaspé limestone series, and nearly the course of an anticlinal, which is doubtless the western extension of that which comes to the shore at Percé. The rocks displayed along the river are blue and grey siliceous limestone, blue and grey thin-bedded limestone, and grey calcareous shales; the thin-bedded limestones are frequently nodular and shaly. The only fossils detected by Mr. Murray in these rocks were fucoids, probably Caudagalli. This would tend to place them on the horizon of the Oriskany formation. The lower thirteen miles are occupied by grey sandstones of the Gaspé sandstone series with plant stems.

The Dartmouth River.

The Dartmouth River was also ascended to a point four miles above the Upper North Fork. On this stream the line of separation between the sandstone and the limestone series cannot be clearly defined, the former, which occupies the lower part of the river to the Falls, about three-eighths of a mile above Lady Steps Creek, has a regular dip 20°-25° W. <35°-40°, and gradually becomes more calcareous. At the Falls the beds contain plant stems, but 100 yards below the second island above the Falls, ledges of hard grey limestone contain abundance of fossils similar to those found on the Griffin Cove River and already mentioned. The dip of these lower beds, which represent the limestone series, is S 15° W <60°. A short distance further up these rocks rest upon black calcareous shales and green-grey sandstones of sillery aspect.

Sillery and Levis rocks.

Thence up stream the river is occupied by calcareous shales, black and grey in color, with bands of limestone, conglomerate and sandstones, resembling the Levis formation, of which they are the undoubted equivalent; but at a point two miles and a-half above the Upper North Fork, greenish grey Sillery sandstones are again overlaid by fine grained limestones and shales in thin bands, containing fossils identical with those noted lower on the stream, and clearly showing the westward extension of the Devonian basin. Above this it was found impossible to proceed owing to the low state of the water, but an attempt will be made during the coming season to complete the traverse of the upper part of this stream, from the Fork River northward.

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* The height of this hill should probably be given at 845 feet above the level of the stream as measured by Aneroid last season.

s exceedingly rich in fossils, large collections of which e at different times by various members of the survey. ng to the lower portion have already been mentioned on and for the sake of comparison other forms, which have d principally by Mr. Billings, are given.

Fossils.

aspé and Bon Ami Cape, which may be taken as repreddle divisions, or, as they have been regarded, the tran- have the following :—

hrentis rugatula.
tyonema splendens.
phomena varistriata.
" *punctulifera.*
diolopsis varia.
urotomaria princessa.
guinolites Tethys.
gula Lucretia.
" *Artemis.*
tamerus galeatus.
nia bella.

per members of the series at Indian Cove, Grand Grêve, pé, we have :—

lipsastrea affinis.
ypora Psyche.
hrentis incondita.
phomena magnifica.
" *rhomboidalis.*
" *Galatea.*
" *magniventra.*
" *inequiradiata.*
" *Irene.*
diolopsis Tethys.
netes melonica.
" *laticosta.*
tocœlia flabellites.
his Livia.
Aurelia.
Lucia.
nchonella excellens.
" *Dryope.*
" *pleiopleura.*
onia peculiaris.
lodictya tarda.

Rensselæria ovoides.
Spirifera Cycloptera.
Spirifera superba.
" *Gaspensis.*
" *raricosta.*
Goniophora mediocris.
Mytilarca nitida.
Leptodomus Canadensis.
Anodontopsis ventricosa.
Cypricardinia distincta.
Murchisonia Hebe.
Platyostoma affinis.
Pleurotomaria Lydia.
" *Voltumna.*
" *Delia.*
Bellerophon plenus,
Phoetus phocion.

From the vicinity of Gaspé and the York and Dartmouth Rivers we have from the basal beds of the Gaspé sandstone:—

Strophomena Blainvillei.
Grammysia Canadensis.
Mytilarca "
Modiomorpha inornata.
Murchisonia egregia.
Leptocoelia flabellites.

By comparing the fossils from the several localities, it will be see that the majority are of Devonian types, and that the serie as a whole belongs much more closely to this system than to th Silurian, though, in the basal beds, forms common to both horizons ar found.

The various members of this system have been so minutely describe in preceding reports, 1844 and 1863, that, with preceding details as t distribution, further remarks are considered unnecessary.

Petroleum.

In regard to the existence of petroleum in the area under consideration, no new facts have been ascertained since the abandonment o operations by the Company, some years ago. Several of the most important oil springs were examined during the past season, but th surface indications are so slight that no satisfactory opinion can fro their mere inspection, be pronounced. The unsuccessful results of th boring operations, in which a very large sum of money was expende prove quite conclusively the difficulty of striking subterranean oi reservoirs in this locality. It is possible that here, as at Lake Ainslie on, and at Beliveau, in New Brunswick, there exists a sub-rock to some extent impregnated with oil, which may surface in small quantities along various vents. At both ces, but more especially at Beliveau, outflows of oil, equal r to any yet observed in Gaspé, are found, but though ms of money have been expended in putting down bore-f which reached a depth of more than 1,200 feet, no satis-ts were obtained.

Galena.

ther indication of mineral wealth observed by us was the galena in small quantities at several points, notably at and Little Gaspé· These localities have been investigated y from Halifax, and small excavations made on the vein. of ore is, however, small, and the operations have been Specimens of the ore from Little Gaspé have been col-ay.

E—SILURIAN.

Distribution of the Silurian strata.

of this system in the area under consideration have but a lopment, being confined principally to a few exposures ast, between Little Pabos and Cape D'Espoir. At the seen they form the beach, and a few feet of the lower part eing overlaid by the Lower Carboniferous beds which have n described. Their first outcrops are observed in Pabos River and on the roads which extend along , about one mile and a-half from its mouth. The consist of greyish limestones and calcareous shales, orals and other fossils of Silurian aspect. These beds easterly towards the mouth of Grand River, on which form high bluffs about the lower part, and extend inland as been examined. They are again concealed from view istance below this river, but in the vicinity of the Breche à they are well exposed in the road leading down to the ll as on the shore for several hundred yards. East of this, st, they have not been recognized, but on the back con-below this stream, the contact of these rocks with the niferous is seen for several miles. In the rear of Cape y apparently pass beneath the Devonian strata, which ex-o Percé.

Gaspé limesone.

ones in the eastern part of the Gaspé Peninsula, which in ts were stated to belong to this system, under the head é Limestones have already been fully discussed in my he Devonian. Of these Gaspé limestones it is now considered that only the two lower members, representing a thickness of 160 feet, can with propriety be assigned to this system, while the preponderance of fossils of Devonian aspect, even in the basal bed, renders it probable that the whole may ultimately be transferred to the Devonian system. Further examinations with a view to determine this point will be made during the coming season.

D—CAMBRO-SILURIAN—(*Quebec Group*).

Detailed descriptions of the various rocks which compose this group have already appeared in various reports and papers, among which may be mentioned those by Sir W. E. Logan, 1844; Murray, 1845–6; Richardson, 1857–58; Geology of Canada, 1863; Selwyn, 1877–78; and Dr. T. S. Hunt; Second Geological Survey of Pennsylvania; Azoic Rocks E. 1878. The explorations of the past season have, however, thrown new light on some points, and will explain certain peculiarities of structure and apparent anomalies of fossil evidence to which attention has not heretofore been specially directed.

Distribution of the Quebec group in the Gaspé Peninsula.

The general distribution of the Quebec group in the Gaspé Peninsula has been shewn on the Geological Map of Canada, 1866. The strata which have been assigned to it, can be easily traced from their most easterly exposure, about two miles and three-fourths south of Cape Rosier, where they are overlaid by the Gaspé limestone series, to Point Levis, and they are easily recognized on the various streams flowing into the St. Lawrence, in nearly all of which the unconformable overlap of the Silurian beds can be observed; and it is interesting to note that in almost every case, these newer rocks rest upon what has generally been regarded as the lower or Levis portion of the group, which in turn is seen to be above, instead of as formerly supposed, below the Sillery.

Oultiers of Utica and Hudson River.

It must be mentioned that attention was called by Mr. C. Weston in 1878, to some new features, shewn by the fossils, principally graptolites, which he collected that year at various points from Cape Rosier to Metis. These included a number of forms peculiar to the horizon of the Utica slate, or Hudson River, and proved that in this area, as in other areas to the southwest, which had till 1876 been regarded as Levis or Lauzon, strata of much more recent age existed. The examinations of the past season have not only further confirmed this supposition, but have enabled us to locate, definitely, some at least of the areas of the newer rocks, the position and details of which will be given in our description of the coast.

By reference to the geological map of Canada (1866), it will be

Formations between Cape Rosier and Metis.

between Cape Rosier and Metis, four formations are
namely, the Levis, Lauzon, Sillery, and Hudson River,
of which is represented as beginning at Little Fox
extending to the Marsouin River. This line is
rongly placed, since, for a distance of over twelve
the former stream, the strata, which are highly fossiliferous,
eristic Utica slate species, while in the other direction the
were observed in the rocks of the beach at and for a mile
outh of the Marsouin.

Levis rocks, Cape Rosier.

easterly exposures of this formation are seen on the south
Rosier Bay, where, as already stated, they underlie the Gaspé
ries. Thence, west from the Cape for about three miles,
a short distance of Marin Brook, the coast is occupied by
rey, and black shales, with interstratified bands of hard
ous sandstone and buff weathering dolomitic limestones.
diate vicinity of the lighthouse, beds of conglomerate, con-
les of limestone, grit and shale occur, the whole presenting
semblance to the recognized Levis beds of Orleans Island.
associated black shales Mr. Weston obtained a variety of
among which the following characteristic Levis species
ecognized :—*Dictyonema irregulare, Graptolithus flexilis, Lo-*
Logani.

bles from the lower band of conglomerates fragments of
ilar to those from Point Levis were also noticed.

Utica slate fossils.

paces below Marin Brook, the red shales which form so
a feature between this point and Cape Rosier suddenly
nd are seen to overlie another set of beds, consisting of
ck slates with hard grey sandstones, the contact indicating
t, the extent of which cannot be determined. The dip of
at this place is S.20°W.<30°, while that of the under-
and grey beds is S.45°W.<70°-80°. This lower series can
the westward for a long distance, and though stratigraph-
uld belong to a lower horizon than the formation just
indeed was supposed till quite recently, it has been found
plentiful fauna, principally of graptolites, which belong to
of the Utica slate or Hudson River. A considerable col-
nade at several points both below Griffin Cove as well
h-west point, among which the following species have been
—*Dicranograptus ramosus, Climacograptus bicornis, Didymo-*
ns, Cœnograptus gracilis, Leptobolus. (?)

Line between Levis and Hudson River strata.

nce of these fossils in the black slates of this area readily
osition, and shows that the line of separation between
d Hudson River formations, as drawn on the general map

(1866), requires to be corrected. It is needless to state, however, that at that time the existence of these fossils was unknown at this locality.

Several compound forms were also obtained from this place which at first sight were thought to belong to the Levis and to indicate a mingling of the different horizons, but a careful subsequent examination showed these also to belong to the age of the Utica.

Fault.

Between the fault which we have taken as marking the contact of the two formations and Griffin Cove, the strata, which are largely black and bituminous, dip S.20°W. to N.30° E.$<$85°-90°. Associated with the soft black and grey shales are beds of hard dark cherty felspathi slate, which will be seen to form a conspicuous member of the formation now under consideration. From the first outcrop of these hard beds in the beach below the Cove they can be traced on their strike westward across the mouth of the Griffin River, where they form ridge lying between the post road and the portage across to Gaspé At Gros Rivière, about half way between this Cove and Fox River they are again seen, as well as at Fox River, where at the branch road up the river, they form a considerable hill. These are the same hard cherty beds mentioned in former reports as occurring at th Marsouin River, and they are also noted by Sir W. E. Logan (Geolog of Canada, 1863, p. 267) about two miles above Cap Rouge. At al these places they are found to be intimately associated with strat which hold fossils of the horizon of the Utica, and attention is particu larly called to these beds since they enable us to locate more definitel the line of contact between the Utica and the Levis both at th Marsouin and at other localities. From Griffin Cove to Grea Fox River black shales and limestones with bands of buff weatherin dolomites, the former veined with white calcite, dip generall S. 40° W. $<$ 35°-60°, and in the vicinity of the latter plac the bituminous portion contains graptolites similar to those jus described, while the grey sandy and calcareous beds contain frag ments of crinoids and small corals. On the west side of Fox Rive the same character is maintained but the strike becomes more westerly following the trend of the shore, the dip being S. 30° W.$<$40°-80 Near the outside of Fox Cove two small local folds are observed in th strata, but these do not apparently affect the regularity of the mea ures.

Cherty beds at contact of formations.

Section at Griffin Cove.

A section made across the strike at Griffin Cove River gives th breadth of this formation there at four miles. The line of contact witl the beds of the Gaspé limestone series is seen a short distance belov the forks with the Ruisseau de la Grande Carrière. The upper mem bers of the Quebec group are fine conglomerates with white quart pebbles, and red, brown and grey shales, which dip generally S.25°W.$<$

down, ledges of limestone conglomerate and black shale
t occur which show an anticlinal structure, having a dip
5°. This, however, soon becomes reversed to S. 25° W. <
ich the stream flows through swamps and exposures are
the road, however, the interval between the exposures
lomerates on the stream and the coast, shows ledges of
-grey sandstone or fine conglomerate, with fine grey,
dish shale, probably of Sillery age. These would underlie
glomerates above mentioned, and be in turn apparently
the black Utica shales of the Cove.

Great Fox River.

at Fox River, for three miles from its mouth, exposures
small branches from the west show fragments of greenish
fine bluish grey and red shales, but at a distance of four
acteristic Sillery or Pillar sandstone is found in place, with
rey shales, which extend for several hundred rods. The
the Levis conglomerates in this direction was not seen,
able they overlie the beds just noted further south, as
upper beds of the formation on the Dartmouth River to
e contact of Levis or Sillery beds with the Utica is also
his stream.
rom the great Fox River, black bituminous shales with
ng dolomite bands and grey calcareous sandstones con-
e coast. These are like the beds of Griffin Cove, and like
graptolites with obolella, and crinoid stems.

Little Fox River.

mentioned, the line is drawn on the General Map at Little
tween the Levis and Hudson River formations. From
ned at this place and below, it is evident that no grounds
ration exist. The crumplings in the strata are local and
ny evidence of great displacement, while the character of
the same for several miles both below and above this
possible, however, that a fault exists here which may
er members of the Utica or Hudson River into view; as
ce above this point, hard grey sandy beds with curiously
ces are seen in force, interstratified with splintery black
sandstones hold imperfect remains of brachiopod shells
ptolites, among which Diplograptus pristis is very com
re also found abundantly at Petite Cap, one mile and a
tle Fox River.

Coast between Petite Cap and Anse a Vallon.

tite Cap and Anse à Vallon we pass three principal
arré, Cape Serpent and Point Jaune. At all these places
black shales with hard grey sandy beds, having the
bed surfaces noted above, are seen. Their strike is con-
g the bend of the shore, which at this locality is N. 50° W.

The angle of dip for half a mile beyond Cape Serpent ranges from 25° to 50°, when it suddenly rises to 80°–90°, which high inclination is maintained to within a short distance of Point Séche.

Great Cloridon River.

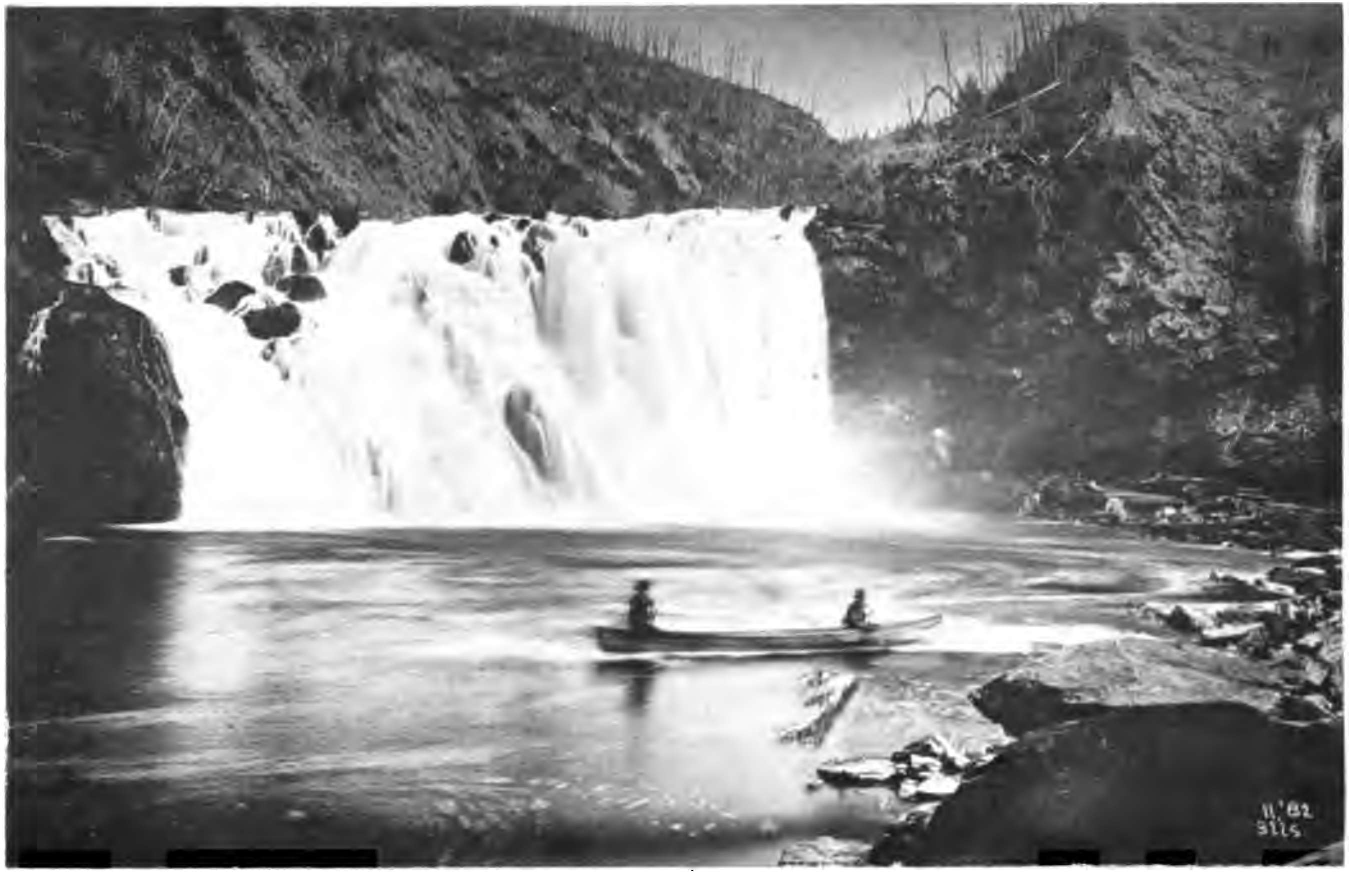
About three-fourths of a mile below this point the dip changes to N.E. < 80°, showing a sharp anticlinal structure. Twenty chains below the Point a well-marked syncline occurs; the dip on the opposite sides being N. 20° E. < 65° and S. 20° W. < 35°. This is again seen in the west side of the Cove above the Point; the opposing angles being 45°, and at fifty chains beyond the entrance another flat anticline is observed, the previous dip having decreased to angles of 4° and 7°. For thirty chains more the dip continues low and then suddenly increases to angles of 30°, forming another well-defined syncline. This is on the shore at Little Cloridon Cove, and it is again seen further west below the mouth of the Great Cloridon River, the strike of the strata keeping regularly along the coast.

West of the mouth of the great Cloridon River, the strata again dip S. 20°. W. < 45°–50°, rising half a mile beyond the point on the west side of the cove to 80°–90° for a short distance, and continuing with a higher inclination to the southwest as far as Little Valley River. The rocks from Anse à Vallon to this place are for the most part hard, grey sandstones, the black and grey shales being in thin bands with a few interstratified beds of buff weathering limestone; the heavy beds of black bituminous shales and limestones, which form so conspicuous a feature between Griffin Cove and Fox River, having become greatly reduced. As, however, the strike of the beds continues to conform with the outline of the shore, but a small thickness of the measures is exposed.

Utica fossils.

At intervals, for the whole distance, graptolites are found, the predominating type being Diplograptus pristis, which is abundant in some of the sandy beds. A compound form was also observed by Mr. Weston, at Anse à Vallon and at Grand Etang, with fragments of corals, crinoids and brachiopods, the examination of which shews them to be of the horizon of the Utica. Similar forms were found at Cloridon, there being very little change in the character of the strata at all these places.

Westward of Little Valley, the angles of dip gradually decline, and at about two miles above Great Valley River, the strata dip S. 5°. W. < 60°. Beyond this, the inclination speedily becomes less steep, with angles of 20°–35° to the mouth of the Magdalen River. The rocks continue to be similar in character for this distance, and hold the same fossils as noted lower down the coast; the Diplograptus pristis being especially abundant. No evidence of anticlinal structure is seen from the Great Cloridon to this river, the rocks having a uniform southerly dip all the way.



From Photo. by R. W. Ells. Geological Survey, 1883.

Artotype—G. E. Desbarats & Co., Montreal.

GRAND FALLS OF THE MAGDALEN RIVER, SIXTY FEET HIGH, FOUR MILES FROM THE MOUTH.

The rocks belong to the Upper or Hudson River division of the Cambro-Silurian (D. 4.) and the surrounding hills, are eight to twelve hundred feet high.

Sections by Mr. Richardson, 1857.

made by Mr. Richardson, from the Grand Etang to the ver (see Report of Progress, 1857, p. 69), gives a surface e rocks under discussion, of about two miles. In that e classed as division A, which was then supposed to con- est member of the Quebec group, as their apparent stra- sition indicates. They are overlaid by greenish grey lding pellucid grains of quartz and small films of black re the representatives of the typical Sillery sandstones. turn succeeded by black and grey shales and beds of stone, associated with red shale and sandstones; and, n the valley of the Dartmouth, by Levis limestone con- d are without doubt the extension westward of the osier; in this river they have been traced from their first t one mile and a half north of Ladysteps Brook, beyond th fork where the stream makes its sharp bend to the

tion further west, measured by Mr. Richardson, on the er (see Report, 1857), gives a similar arrangement of he Utica, or Hudson River beds, near the mouth of the arked by characteristic fossils, both brachiopods and ong the former, Orthis testudinaria and Leptœna sericea, t, and are well exposed for over four miles across the bout one mile above the Grand Falls, above which the flat as far as Porcupine Bluff. Here strata of Levis pect apparently overlie the Utica, though the contact is consist of green grey sandstones, with red and grey shales, and resting upon them, are the conglomerate limestones beds of the Levis formation, which are in turn uncon- aid by the Gaspé limestone series.

Levis strata overlying Utica.

Magdalen River, the rocks resemble in character those coast to the east, being for the most part black and th buff weathering dolomites and interstratified beds of stone. These differ from the typical sillery or pillar he absence of the grains of clear quartz and films of well as in their being more compact and homogeneous. f one mile west of the lighthouse at the mouth of the fined synclinal is observed with opposing angles of 50° is again brought into view half a mile further on in a hence upward to Marsh Bay, the beds strike regularly e with a dip S <50°-75°, but shew an anticlinal struc- e east of Marsh Bay Beach. One mile west of this place gain reversed, forming a synclinal with angles of 75°, cal syncline occurs one mile and a half east of Gros Mâule

Marsh Bay.

At this river, and for several miles above and below, the heavy blac bituminous shales of Griffin Cove are again strongly developed, ar form bold and high cliffs. They contain abundance of graptolites, large collection of which was made in 1878 by Mr. Weston. Amon these may be mentioned:—*Climacograptus bicornis, Dicranograpt ramosus, Diplograptus pristis, Cœnograptus gracilis, Graptolithus scalar Orthoceras.*

No mingling of Utica and Levis fossils.

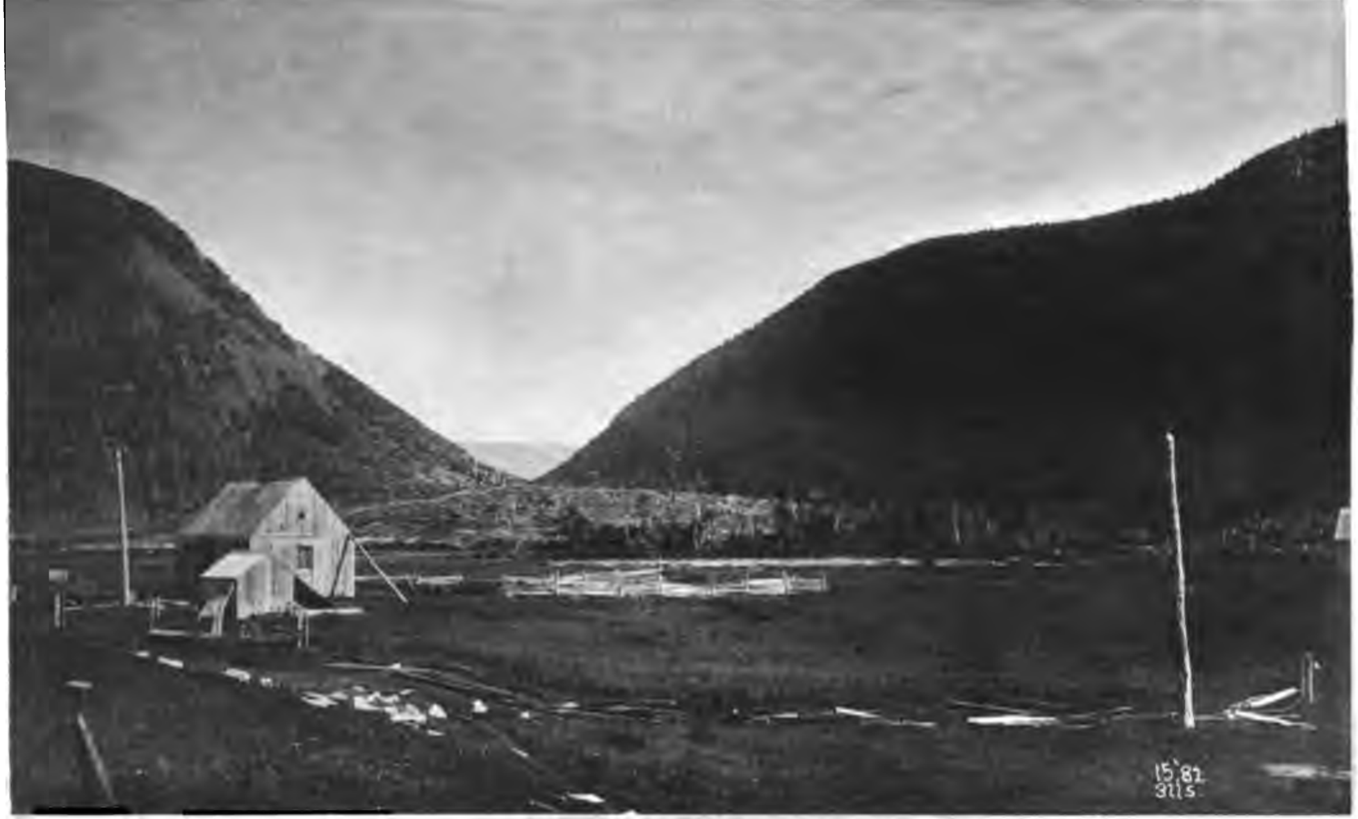
It will be seen that these species are all of the horizon of the Utic but in Hall's "Graptolites of the Quebec Group, Dec. 2, 1865," sever forms peculiar to the Levis formation are mentioned, probably in erro as having been found at this place. Since then, however, it has be ascertained that the Levis forms marked Gros Mâule were wrong marked, and that they belonged to another locality. This gave ri to the supposition that at this place there was a mingling of the faun of the two horizons, but it may be said, after careful examination, th no other fossils than those of the Utica slate could be found. T lithological character of the rocks also clearly distinguishes them fro the Levis beds, and taken in connection with the stratigraph indicates that the Utica and Hudson River are continuous from belo Griffin Cove to this place. And we may here remark that, at no pla where fossils have been collected, do we find any mingling of the tw faunas in the same bed, though in some localities the associati of the strata of the Levis with the Utica is very intimate, as will seen as we proceed further up the coast.

Gros Maule to Marsouin River.

Between Gros Mâule and the Marsouin River an anticlinal stru ture appears to follow the bend of the shore line for the greater part the distance. The inclination of the angles being often very low, a the shallow synclines coming to the shore obliquely from the riv Beautiful exhibitions of contorted strata are visible at several poin among which may be mentioned the west side of Mont Louis Cove a the Grand Matte, the disturbances along this part of the coast prese ing the aspect of a crumpled anticlinal. No change in the charac of the rock is apparent, the interstratified beds of hard grey sandsto having the same peculiar knobbed surfaces as were noted in the vicin of Little Fox River, and at other points to the east. They conta abundance of Diplograptus pristis, and there is no doubt that the ro all along this part of the St. Lawrence belong to the same horizon.

Fault at the Marsouin River.

Just below the mouth of the Marsouin River evidences of a fault a apparent. Hard grey sandstone with partings of grey sandy sha extend almost the whole distance from Abour Brook, and apparen overlie the black graptolitic beds of Gros Mâule. These sandstones c tain D. pristis, and are possibly a portion of the Hudson River forn tion. At the mouth of the Marsouin they dip N 65°W<40°, and at



From Photo. by R. W. Ells. Geological Survey, 1883. *Artotype—G. E. Desbarats & Co., Montreal*

GORGE AT THE MOUTH OF THE GRAND MATTE RIVER, FIFTEEN MILES WEST OF THE MAGDALEN RIVER

The hills are ten to fourteen hundred feet high, and shew beautiful cliff sections of the contorted strata belonging to the Levis formation (C. 3.)

the Cove just above, hard dark cherty felspathic slates of a
zon dip S 25°W <30°, and constitute also the ledgy islet at
of the River. It was at first thought that the want of con-
rked the line of the great fault between the Utica and Levis
but from the fact that the hard cherty shales have been
rious points to form an integral part of the Utica and that
hitic shales, with other beds holding abundance of Utica
tinue to occupy the shore for a further distance of over one
the mouth of the river, it is evident that this fault is local.
t of the Utica with the Levis can, however, be seen on the
e distance mentioned, the latter strata of red and green
their conglomerates constituting the cliff, while the former
y the shore, and gradually pass under the waters of the St.
As at other points the beds of the Levis apparently rest
Jtica, which, at their contact, has a dip S<50°-60°.
e black graphitic shales west of the Marsouin, the following
Jtica types have been obtained :—

Dicranograptus ramosus.
Diplograptus pristis.
" *mucronatus.*
Graptolithus tenuis.
Leptobolus insignis.

then, the section along the coast from Cape Rosier to the
River confirms the existence of two distinct formations,
parable on palœontological if not always on stratigraphical,
of which the lower contains characteristic compound
peculiar to the Levis, and in which no distinct fossils of the
the Utica or Hudson River have been recognized. This
s, while it has an exposed area along the coast of only three
half west from Cape Rosier, is continuous the whole way at a
from one to four miles inland. The newer formation, begin-
vicinity of Marin Brook, occupies the shore continuously to
in, and while it contains none of the fauna of the Levis beds,
nearly every point for the entire distance, an abundance of
and other forms peculiar to the horizon of the Utica or
iver. It is worthy of remark also that in every observed
e Levis beds appear to be superimposed upon the Utica, as
nd of Orleans. Westward of the Marsouin, until the present
rocks of recognized Utica slate age had been definitely
though such areas have lately been supposed to exist, but
examinations of the past season these were found at several
Also the discovery of fossils of the newer series at various

Coast section from Cape Rosier to the Marsouin River.

Apparent super-position of the older series.

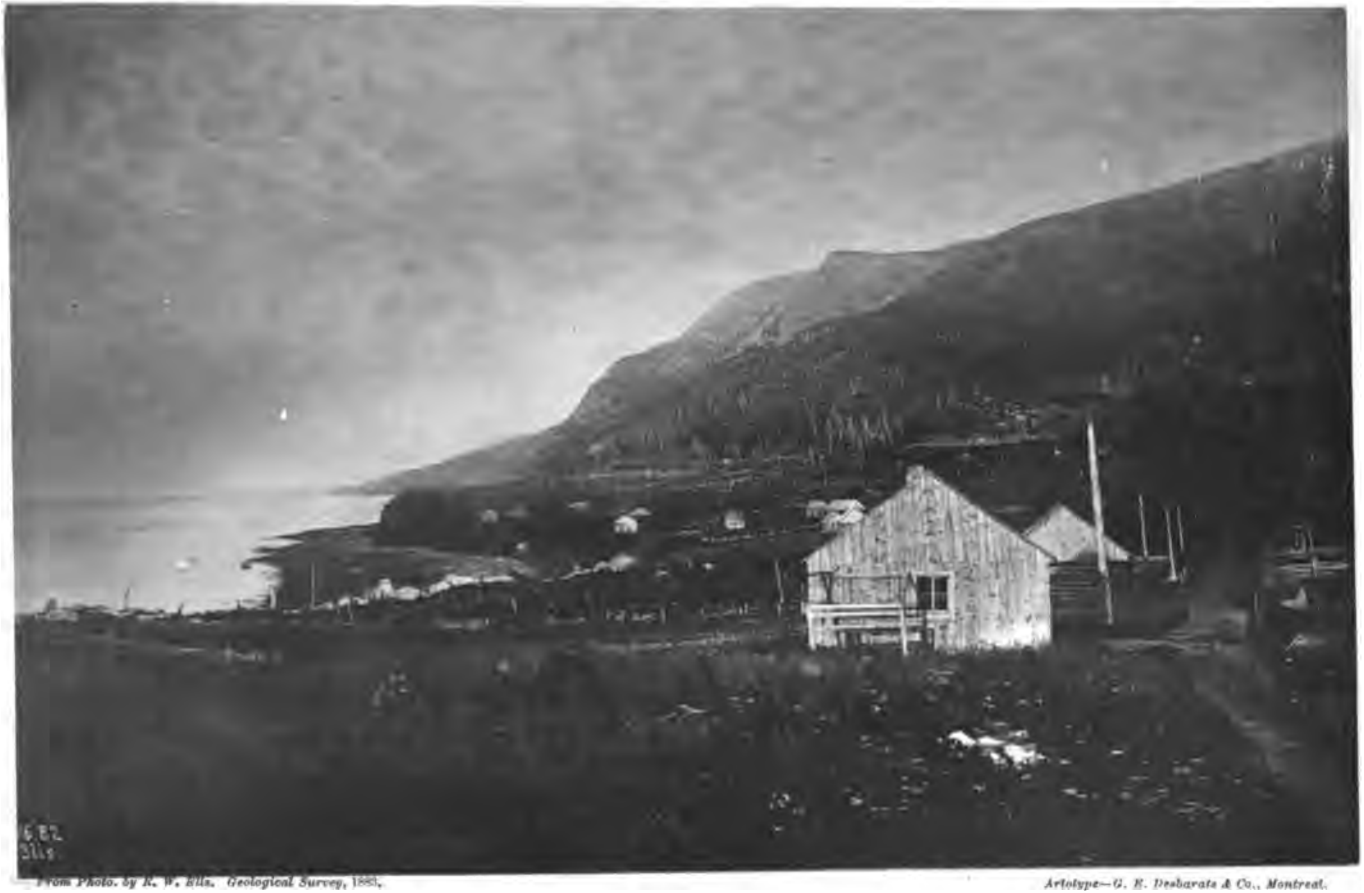
points between St. Anne and Metis in rocks which have been regarded as belonging to the typical Levis and Lauzon formations, opens up the question as to how much of the so-called Levis in this north-eastern area may now be considered as belonging to a more recent formation. The distribution of these areas will now be considered.

Passing the mouth of the Marsouin River we find the beach as stated for a distance of 100 chains, occupied by the rocks just described, while the cliff is composed of red, green and grey shales resembling the strata seen to the south of Cape Rosier. The beds of the beach, which dip S. 25° E. < 60°, are seen to pass under the waters of the River at this distance, the last beds exposed being hard cherty felspathic slates like those of Fox River, upon which the older rocks rest unconformably, the angles of dip at the contact being 40° and 70°. Thence up the coast to Ruisseau Valleé, about six miles, strata of red, green and banded shales, with buff weathering limestone and occasional beds of green-grey sandstone containing small grains of clear quartz and films of black shale occur, the latter being similar to the pillar sandstone in the vicinity of St. Anne's. All these strata resemble what have been called in earlier reports the Sillery and Lauzon divisions.

The structure of this part of the coast is very simple. At two points a synclinal with associated anticlinal occurs, the first at a distance of two miles from the contact mentioned above, the other 100 chains west of the River Martin, but from the run of the strata it is evident that both these exposures are on the same axis.

Ruisseau Valee.

West of the Ruisseau Valleé, grey grits and shales with a few limestone bands strike out to sea at a moderate angle for two miles, where a sharp synclinal with an equally abrupt anticlinal is seen. These can be traced up the shore for several miles, or to within four miles of the St. Anne's River, in which distance the anticlinal axis, which curves along the shore, is crossed by the coast section no less than seven times. The rocks are principally sandstones of Sillery aspect, or what have been described in former reports as Pillar sandstones, from the peculiar pillar-like masses which stand up from the beach between the Ruisseau Castor and Potato Brook. A short distance below the latter stream the sandy beds again strike out to sea with a dip of N.10° E. <80°, and give place along the beach to red, grey and green shales with dolomite bands, which are apparently a portion of the sandstone series, since they conform in dip and direction. Above the brook the dip becomes reversed to S. < 75°, and between this and Little St. Anne Point the strata are a good deal disturbed. At this point the rocks, which consist of broken grey limestones with shales of various shades, contain an interstratified band of conglomerate limestone, which marks the first exposure of this kind along the shore since leaving Cape Rosier.



From Photo. by R. W. Ells. Geological Survey, 1883.

Artotype—G. E. Desbarats & Co., Montreal.

COAST BELOW RUISSEAU CASTOR, TEN MILES EAST OF STE-ANNE DES MONTS.

The high hills are composed principally of the Sillery Sandstone division of the Quebec group and terminate on the shore in abrupt cliffs eight to twelve hundred feet high.

the mouth of the St. Anne River the purple grey and
s continue.

Aspect of the beds above the Marsouin River.

of the various beds seen above the Marsouin, is that of
and Sillery divisions, but at a distance of one mile
est of the great Ste. Anne River, a set of beds which are
s in character, come in on the shore and form also two
t local ridges about half a mile inland. These consist of
nglomerate often coarse, with associated beds of hard,
tzite, or quartzose sandstone, and thin red, black and grey
se have been correlated by former observers with the beds
is and Bic, of which they are apparently the equivalents.
bbles of the conglomerate, Salterella has been obtained.
mentioned have a superficial breadth of about ten chains,
e larger part is occupied by soft shales, separating the
conglomerate portions, and they extend along the strike
nty chains, sinking down quite abruptly at either end to
he terrace from which they rise; the strike of the beds is
W., the angle of dip being N. 20° E. < 60°.
from these outcrops, the shore at low water presents
These shew, at the outer margin, an anticlinal structure
omerate and grit portion, with opposing dip of 75°, and
shoreward by a series of slates and arenaceous limestone
cter just described. They present a marked resemblance
seen at Cape Rosier, of which they are the undoubted
nd can be traced up the shore for about three-fourths of
e they give place to grey, green, and purple clouded
thence occupy the coast towards Cape Chat. The lime-
nerates are very irregular in their distribution, and cannot
any considerable distance in their strike, often abruptly
by faulting or thinning out; evidences of both being fre-
le. The black associated shales contain frequent nodules,
rd and cherty and often calcareous: cracks in these con-
carbonaceous matter found in the beds on Orleans Island
is and elsewhere. Among the fossils collected from these
wing typical Levis forms have been recognized:

Calcareous nodules in the black shales.

Levis fossils.

Graptolithus bifidus.
" *similis.*
" *pennatulus.*
" *bryonoides.*
" *fruticosus,*
" *Richardsoni.*
Phyllograptus Anna.
Thamnograptus Anna.

Cape Chat sandstones.

This locality is about three miles west of St. Annes, des Monts Ri Thence up to the point below the Cape Chat River, red, green and g shales, often confused, occupy the shore, and are similar to those scribed as holding graptolites of Levis types. They all have a south or southeasterly dip, with angles from 35° to 60°. At the point miles below Cape Chat River, sandstones of typical Sillery aspect, interstratified grey and black shales again come in and appare underlie those just described. These beds are better seen above mouth of the river, and between that place and Cape Chat, are stro developed. They present a curved structure, and strike seawar their upper exposure, beyond the lighthouse, with a dip S. 10° W 35°–60°, directly underlying banded red, green, and black shales.

It may be well to mention that, in the sandstones now under cussion, the characteristic fossil *Phyllograptus typus*, so commo beds at Point Levis, associated with the conglomerates, has been fo by Mr. Richardson, showing that these rocks are of the same hori

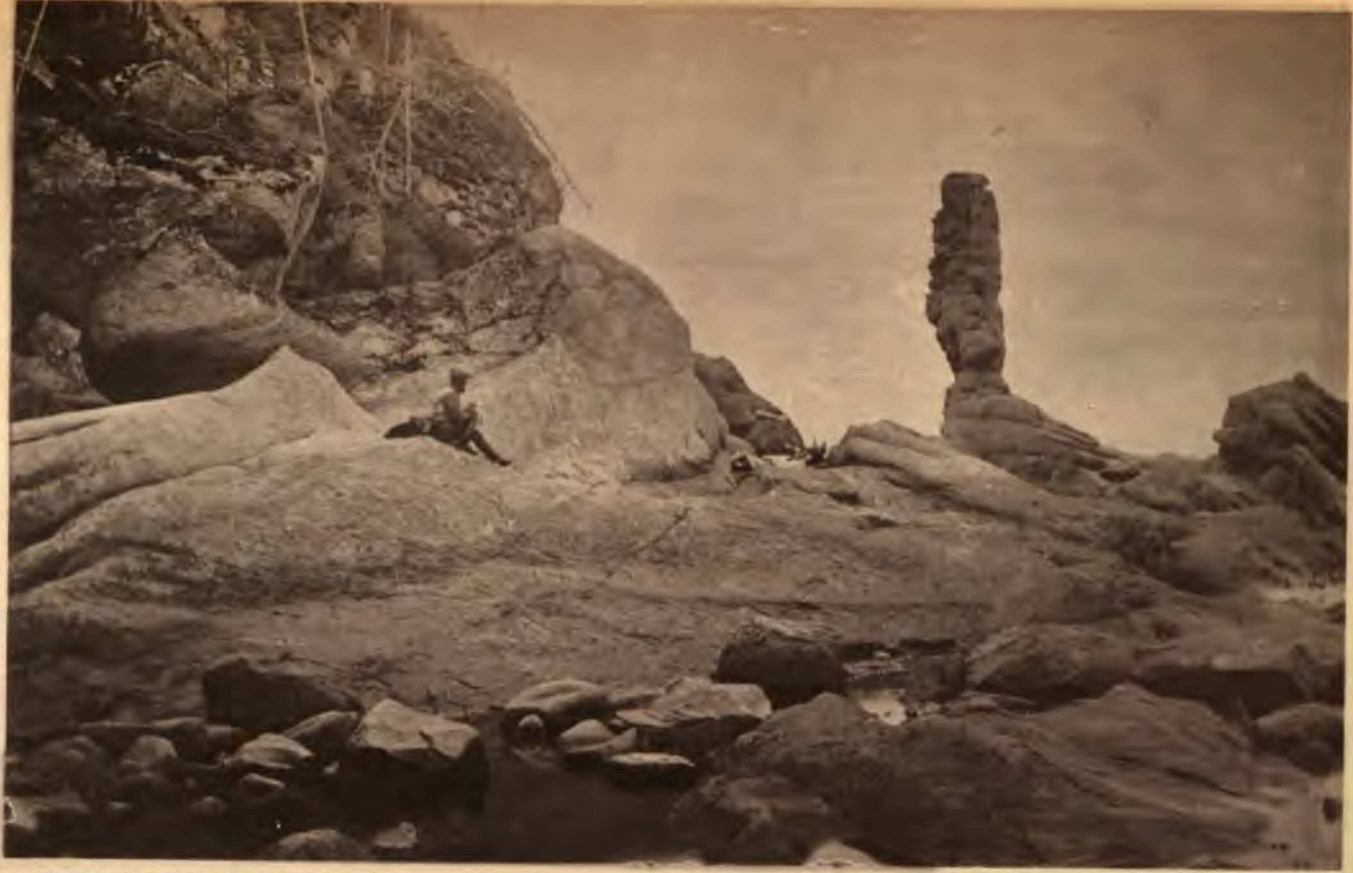
The shales referred to in the preceding paragraph are, however, an interstratified belt with the sandstones, to which they conform in and have an exposed length of only a few chains, the coast above b occupied by interstratified beds of Sillery sandstone and shales of ious colors as far as Little Michaud Bay. Sharp foldings are see the rocks at Little Capuchin Bay, as well as on the point between and the Great Capuchin, and about three fourths of a mile below former place the interstratified black shales were found to contain *Dictyonema* and *Graptolites*, among which *Loganograptus Logani* *Callograptus* were recognized. At Great Capuchin, on the west sid the Cove, the Sillery sandstones are in contact with deep red sh which are mentioned by Mr. Richardson (Report 1857, p. 142) as taining copper ore in small quantity, and then supposed by apparently for this reason only, to form the eastern extension of copper-bearing beds of the Eastern Townships. The beds at the tact with the red shales have a vertical position, while the general of the sandstone across the point is only 40° to 55°.

Copper ore supposed to indicate the position of the strata.

Sillery sandstones, Little Michaud Bay.

The Sillery sandstones are strongly developed along the shore t east side of Little Michaud Bay and terminate about 200 paces ea the bridge over that stream, west of which along the beach exposures are seen for half a mile, the dip of the last beds of sandstone being S. 25° E. <65°. The next beds seen after passing sandy beach are soft black and dark grey shales with hard grey b like those seen about Griffin Cove. These are found to contai abundance of graptolites, among which Mr. Ami has recognized :-

Dicranograptus ramosus.
Diplograptus pristis.
Didymograptus divaricatus.



From Photo. by R. W. Ells. Geological Survey, 1883.

Artotype—G. E. Desbarats & Co., Montreal.

SANDSTONE PILLAR ON THE COAST, EIGHT AND A HALF MILES EAST OF STE-ANNE DES MONTS.

The name "Pillar Sandstone" applied to the Sillery division in the Reports of 1845 and 1859, was derived from these pillars of which there are several in the vicinity.

Great and Little Michaud Coves.

es of these shales are, however, limited to a superficial
more than fifteen chains, the dip is S. 40° E. < 80°, and
ne inner portion of the west side of the Little Michaud
nderlaid seaward by red, green and grey shales of Sillery
occurrence here of this band of Utica or Hudson River
nteresting, and is doubtless due to the intimate infolding
n the older formation.

Les Islets.

Section by Mr. Richardson, 1858.

shales and limestones along the east side of the Great
, which are probably the extension of the fossiliferous
cribed, heavy beds of quartzose sandstone and limestone
similar to those seen at St. Anne, form a prominent
0 paces back from the shore and extend towards the
River; they have a southerly dip at a high angle, and,
les, fragments of trilobites, which are like those from the
of Bic, and *Salterella* were obtained by Mr. Weston
side of Great Michaud Cove brings into view a repetition
merate limestone and associated grey and black shales.
e like those seen above the Ste. Anne River, and the
slates contain typical Levis fossils. It is interesting to
pieces of shale which enter into the composition of this
also contain graptolites, among which *Tetragraptus*
n allied form, has been recognized. From the end of the
ud Point to Les Islets about two miles west, beds of
vnish grey, calcareous shales with dolomitic bands and,
r portion, heavy beds of coarse oolitic limestone are
hese beds have a southerly dip at angles of 30° to 40°,
place about one mile west of the point to 80°, where a
isible in the grey calcareous shales. At Les Islets, coarse
limestone with heavy bands of grey or brownish grey
dstones are largely developed, with interstratified beds of
grey shales, and continue to form a very rough coast
les, or to the mouth of the Gros Roches Brook. The dip
the south-east at angles of 30° to 45°, rising at one point
midway between the two places where indications of an
ticlinal are visible. A section given by Mr. Richardson
or 1858, p. 144–6) makes the thickness of the measures
le of the axis to be 667 feet.

onglomerates' and associated rocks present a marked re-
rocks in the vicinity of Bic and other points farther west.
frequently contain *Salterella*, while the interstratified
graptolites of Levis types. Among these the following
collected by Mr. Weston, principally in the vicinity of
ud Point:

ichograptus ramulus.

Tetragraptus quadribranchiatus.
" *fruticosus.*
Dendrograptus.
Callograptus.

Although these beds are apparently higher in position than th west of Les Islets, the occurrence of similar Levis fossils in the sha of the latter, shews them to be of not very different horizons. Th the evidence is entirely opposed to their being of Potsdam age.

Gros Roches Brook.

West of Gros Roches Brook, beds of red, green and black variega shales, with bands of limestone and green, grey sandstone again co in, apparently underlying the conglomerates just described. Th resemble the typical Sillery, and extend for about two miles, or alm to Anse du Tour, where heavy beds of sandstone occupy the shore force, and extend thence to Whale Point. The shaly portion w of Gros Roches, shews evidence of crumpling, which, however, may only local. Rounding Cape Whale Point, these red and green sha with interstratified beds of green sandstone, extend for a short distan evidently as a part of the Sillery series, the sandy portion of which again rapidly developed, and continues without interruption to Lo Point about four miles farther. In this stretch there are several int stratified bands of red shale, but after passing to the west side of Lo Point, a fault brings in the crumpled limestones and shales of the Le formation, the latter containing:

Fault.

Tetragraptus fruticosus.
Dicthograptus flexilis.
Dictyonema.

Great and Little Matanne Rivers.

Associated with these are beds of conglomerate limestone and ha quartzose sandstone, like the rocks of Les Islets. This series exte up to the great Matanne River, half way between which and Lit Matanne, beds of blackish grey shale, with dolomite bands, cont graptolites and other fossils, among which the following species ha been determined:

Dicthograptus rigidus.
" *flexilis.*
Dictyonema irregulare.

Fragments of trilobites were also obtained from associated stra but these were not perfect enough to be determined.

These beds apparently all overlie the so-called Sillery sandston and as the same stratigraphical relations of the two divisions of the f mation are exhibited at nearly every observed contact, it is evident t the supposed lower position of the graptolite shales can only be ma

ie assumption that the whole group has been completely
of which there is no evidence.

Great Matanne no exposures are seen on the beach for four
which, to the mouth of the Tartigo River, shales of
urs with beds of green-grey sandstone again occupy the
se have a general south-easterly dip at various angles, and
nderlie the heavy masses of coarse limestone conglomer-
l sandstone, which constitute the prominent ridges about
land on the Great and Little White Rivers, and large blocks
seen on the coast near the mouth of these streams. The
veral places contain abundance of graptolites and other
evis types. *Dichograptus flexilis* and *Dictyonema* were **Fossils.**
out one mile and a half below the Little White River, and
mile and a half below the Tartigo, a *Dictyonema* and *Tham-
na.*

his place, however, black bituminous shales with grey
dolomitic beds occur, and form a narrow selvage for a
ce along the shore, and apparently dip under the fossil-
s beds just described. These shales resemble lithologically
ffin Cove, and like them have yielded graptolites of Utica
a collection made here by Mr. Weston, Mr. Ami has

Climacograptus bicornis.
Didymograptus sextans.
Dicranograptus furcatus.
Retiograptus, sp. indet.

ds extend along the shore about fifty-five chains, above **Tartigo River.**
e mouth of the Tartigo River, large masses of red and
are exposed on the flats at low water, and include near the
e river thin bands of conglomerate, the whole series dip-
<35° 40°.

n found impossible to trace the bands of conglomerate and
one referred to for any considerable distance continuously
e irregularity of their outcrop.

mouth of the Tartigo River, black shales with buff weath-
again reach the shore, and form almost continuous ex-
two miles and a half; the gritty and calcareous bands, con-
rinites and fragments of *Stictopora acuta* while the
exceedingly rich in fossils, principally graptolites. At
each they yielded:

Cœnograptus gracilis.
Climacograptus bicornis.

Dicranograptus ramosus.
Diplograptus pristis.
" *annectaus.*
" *sextans.*
Graptolithus scalaris.
Orthoceras lamellosum.

The strata from which these species were obtained resemble precis those of Griffin Cove, not only in the character of their various roc but in the presence of the same hard cherty felspathic slates wh form so marked a feature there and elsewhere. These areas of hig fossiliferous shales which are now for the first time definitely loca and recognized as of Utica or Hudson River age, though closely asso ted in the manner described with Levis rocks, are exceedingly inter ing and important, and it may be presumed that further examinat of the Quebec group, on the south shore of the St. Lawrence, reveal, as it has done to the south-west, the existence of other sim outliers.

Two miles and a half west of the Tartigo River the newer strata apparently, under red, grey and banded slates similar to those be that stream which thence extend to MacNider Bay. In this dista are included bands of conglomerate limestone and other rocks, whole resembling the strata at Les Islets and Gros Crapauds. T have a general strike along the shore but exhibit several anticli folds, and at the upper part of MacNider Bay are seen to rest u the green grey Sillery sandstone, both series dipping south-easterly angles of 50°-70°.

Little Metis River.

From MacNider Bay to within a short distance of the mout Little Metis River, the Sillery sandstone and associated red and g shales occupy the shore, but from the upper hotel to the mouth of stream hard whitish weathering quartzose beds with thin bands of li stone conglomerate of Levis aspect rest again upon the sandy beds, dip of the upper portion being S. 30° E. < 50°.

Between the mouth of Little Metis River and the lighthouse at Point on the north-west side of the Cove, the Sillery sandstones largely developed. They occupy the shore west from the p to the beginning of the Cove east of the Great Metis R at which place they underlie red, grey and banded slates, which ext thence to the mouth of the latter stream where they are again i mately associated with limestone conglomerates of the Levis for tion. This point marks the western limit of our observations al the coast.

It will be seen from the facts here presented and from the inspec of the accompanying map that several important changes have

Changes in the supposed distribution of the formations.

istribution of the various formations. The intimate
f the red and green shales of the Lanzon with
y sandstones and other beds of the Sillery make it evi-
his area at least the separation of these two formations
, while the evident superposition of the Levis division
ry at so many points renders it probable that the latter
basal portion. Further examination of the conglomer-
s, with special reference to their contained fossils, will
w new light on this point; the presence of grapto-
pieces of shale which help to make up these
shews that a part of these rocks at least are newer
the fossiliferous shales of the Levis. The im-
tracing in detail the different divisions for any great
country covered by dense forest and accessible only by a
on which even continuous outcrops are not found, is
ile the numerous dislocations and disturbances of the
the accurate portraying of the different members, from
one, except by actual exposures extremely unsatisfactory
refore deemed it best to include the whole group in one
the heading Upper Cambrian, notwithstanding it in-
ous outliers of Cambro-Silurian formations — Utica and
, — but presents no evidence of any Potsdam or Lower
ta.

Classification of the formations.

Explanation of the outliers of newer rocks.

f the great fault between the Utica or Hudson River and
ion has been clearly defined at several points along its
sion, while the detached areas or outliers of the upper
are generally of small extent, appearing to form an
on of the Levis, is fully explained by supposing them
caught up and infolded with the older strata in some of
mplings and apparent overturns which have affected the
to the south-east of the great St. Lawrence and Champlain

IGNEOUS ROCKS.

Trap dykes.

exposures of trappean rocks, which are seen to cut the
ta under consideration, have been fully described by Sir
(Report 1844, p. 40). Five are there mentioned, all of
he aspect of true dykes. Three of these occur on the
Gaspé Bay, of which the most easterly is one mile and a
of the outside point of Little Gaspé Cove; the second, 300
Little Cape Oiseau, and the third, 300 yards above the

---

ks must not be taken as applying to the metamorphic area as displayed in the
that area not having yet been closely examined.

same point. The fourth occurs at Anse Cousin, one mile and th quarters above the bluff on the upper side of the entrance to the S. arm. The fifth is that seen at Tar Point, and is chiefly remarkable the presence of petroleum which occurs, sometimes solid and someti liquid, in numerous drusy cavities, disseminated through the trap, which are often lined with chalcedony. None of these dykes have apparent breadth greater than ten to twelve yards; and from the of their having indurated or otherwise altered the sandstone st with which they are in contact, it is evident that their age is subsequ to the deposition of this portion of the Devonian.

Petroleum.

Another trap dyke, observed by us last season, is on the back con sion, near the western boundary of the township of Percé. exposure here has a surface breadth of 260 paces, and is surrounded sandy slates, presumably of Silurian age, but largely concealed by overlapping Lower Carboniferous sediments. The trap is of a ha steely grey color, heavy and crystalline in character, and form knob over which the road passes with an abrupt descent on eastern side.

GICAL SURVEY OF CANADA.
ED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR.

NOTES

ON

SOME OF THE MINES

IN THE

VINCE OF QUEBEC.

BY

CHAS. W. WILLIMOTT.

1882.

UBLISHED BY AUTHORITY OF PARLIAMENT.

Montreal:
DAWSON BROTHERS.
1883.

R. C. Selwyn, Esq., LL.D., F.R.S., F.G.S., &c.,

ector of the Geological and Natural History Survey of Canada:

ompliance with your instructions, I visited during the past
ne of the mines in the province of Quebec, with a view to
useum collections, and also to obtain material for making
ons for distribution to educational institutions.
ts visited were those best known to afford characteristic
nd where recent excavations may have made these more
Statistics of the mines visited were carefully collected, and
plementary to the object in view, these may nevertheless
g. Fifty-two different mineral species were collected, the
ber being from the Apatite mines in Ottawa county, the
om the Eastern Townships.

I have the honor to be,

Sir,

Your obedient servant,

CHAS. W. WILLIMOTT.

y, 1883.

NOTES

ON

SOME OF THE MINES

IN THE

VINCE OF QUEBEC.

BY

CHAS. W. WILLIMOTT.

COPPER.

Mines.—These mines are situated on the 17th lot, in the
Leeds, in the county of Megantic. Before they were
he Company's attention was directed more especially to
and the Fanny Eliza vein described in the Geology of
728. Of the two levels that have been driven, only in the
has any further work been done since the publication
1863, pp. 725–729. This level has been extended to
west; from it an incline at an angle of 45 degrees
for a distance of 600 feet; some very rich pockets
been met with. The Fanny Eliza vein has yielded
cent.

s are filled with quartz and dolomite, mixed with a
y of purple copper. Sometimes the pockets hold ore
dded rounded crystals of quartz. In some instances the
by reticulating masses of chloritoid, and in rare cases
ls are associated.

f my visit, in August, 1882, three men employed by a
pany, (the present owners) were taking the water out
h a hand windlass. This work had then occupied them

The manager states that it is the intention of the Company t
mence mining next year, as soon as the snow is off the ground.
intend to sink new shafts, and should the result prove satis
they will erect smelting furnaces.

On the next lot No. 18, in the same range, a small opening h
made in the hydro-mica schists to the depth of six feet, on a
vitreous ore, (chalcocite) in a matrix of decomposed bitter spa
vein is traversed by bands of chlorite, often arranged in al
layers with quartz, and resembling the structure of Eozoon lim
The ore is reported to have yielded on assay 8 ozs. of silver to t

Ascot Mine.—This mine, situated on the 8th lot of the 8th con
in the township of Ascot, has now become the property of th
brooke Mining and Smelting Company, who are determined to
operations on a more extensive scale.

The shaft which is about 150 feet deep, was being emptied o
when visited in 1882.

The ore, yellow sulphuret, is derived from a two feet bed in c
mica schist. It is stated to average about 7 per cent. of
copper.

Hepburn Mine.—This mine, situated about 3000 feet to the
of the Ascot Mine, is also the property of the Sherbrooke Min
Smelting Company. A shaft has been sunk to the depth of 15
At sixty feet, a level has been driven thirty feet, from this a no
a south cross-cut was made; the latter was carried 110 feet, at
distance a bed of yellow sulphide, twenty-four feet thick w
averaging about 7 per cent. metallic copper. The north cross-
carried 125 feet where another bed of yelllow ore was cut, said
twenty-seven feet thick.

No ore has been raised, the object of the Company being to
a large reserve.

About twenty men are employed at this mine.

Suffield Mine.—This mine, situated on the 3rd lot of the 13
cession of Ascot, is also the property of the Sherbrooke Mini
Smelting Company. A shaft has been sunk 200 feet; at the de
eighty-five feet, and 200 feet, levels have been driven to the e
former 300 feet and the latter 100 feet, connected by a vent
winze.

The amount of exposed ore is about 40,000 tons, 3,500 to 4,00
have been taken out and will be concentrated and smelted at the

Mr. Stewart, the Company's obliging superintendent, informed
with the present appliances they can take out seventy-five tons
The drilling is done by an air compressor driven by an engine o

The drills which have a stroke of 3½ inches and make
the minute, penetrate eight feet in 45 minutes.
f the ore is of a very fine texture, and varies in color from
o a pale yellow. It resembles portions of the Hartford
ribed by Dr. Harrington as tetrahedrite. (*Geol. Survey*
–78, p. 52.)
s is frequently associated with it, both in granular masses
es.
re made by John Massey & Co., London, England, gave
from 8 ozs. to 235 ozs. to the ton, and from 4 to 29
etallic copper.
are employed at this mine.

IRON ORE.

the 10th lot of the 15th range, in the township of Leeds,
iron ore, described in the Geology of Canada, 1863, p. 677,
n found in situ and traced a considerable distance. Several
re were shipped some time ago to the St. Maurice Forges
proved to be of good quality.
t.—On the 43rd lot of St. Armand east, a small opening
de, on what appears to be at first glance, an epidotic
ay possibly be a thin vein. It is almost vertical, and is
ther side by epidotic amygdaloid and chloritic schists.
c rocks, hold small shining plates and crystals of specular
extent of about 5 per cent. I need hardly say this
d not prove remunerative.
On the 1st range, between the 22nd and 24th lots, a bed
occurs. It is about eleven feet wide and overlaid by ser-

Quebec.—On the north half of lot 7, in the 1st range of
vein of magnetite was met with, about 4 feet in width.
merous detached crystals on the surface which have been
the disintegrating limestone that forms the walls of the

occurs also on the south half of the same lot in veins,
istributed through a pyroxene rock.

ANTIMONY.

uebec.—At the antimony mine of South Ham, situated on
of the 1st range, on the property of Mr. W. Russell, of
n visited in August, some preliminary work was being
all gang of men, who were employed removing detatched
from the bottom of the shaft, which had caved in through

unskilful working, having caused the timbers to give way. It is
intention of the owner to sink 10 fathoms deeper. 15 yards off, a do
shaft has been sunk to the depth of 100 feet, in black argillac
slate, holding disseminated grains and crystals of native antim
Pockets of the sulphide (stibnite) are occasionally met with.

Two or three levels have been driven short distances, but with
result I was unable to ascertain; judging from what had been excava
none of the ore would average more than 5 per cent., exclusive of s
very rich pockets said to have been extracted.

Two hundred yards east of this shaft another opening has been
to the depth of 12 feet, and judging from the dumps of extra
minerals, some very rich pockets of native antimony have been t
out; the presence of the sulphide is marked only by small aci
crystals that are sometimes met with in cavities in the wall roc

The minerals of antimony that have been noticed at this mine ar

1. Native Antimony distributed through a great thickness of a
laceous slate, in disseminated grains, and small crystals; the la
however, are confined to the veins. This deposit may be regard
an interstratified bed, alternating with other rocks of a more mica
nature. A highly lustrous variety of native antimony fills some o
pockets, which abound in the region of the slates. It is invari
associated with the oxysulphide (kermesite) in diverging masses
capillary tufts. The color of the latter varying from dark cherry
to almost white.

2. A granular variety of valentinite intersected by small cryst
the same mineral, sometimes accompanied by rounded crysta
quartz, constitutes the filling material of some of the veins, and lik
native metal is associated with kermesite, in, however, a more adva
state of decomposition. Besides the massive variety, small but
defined crystals of valentinite and senarmontite may frequentl
seen lining cavities near to the walls of the vein. In breaking
specimens of the native antimony, obscure diverging blades
noticed, and it appears that the kermesite, and the native metal
has been derived from the sulphide.

The passage of the sulphide to kermesite is shewn by the latter
fractured often exhibiting included portions of sulphide. This acc
in some measure for the sulphide which elsewhere appears to b
most abundant form being here comparatively rare. The b
material averages about 5 per cent., and has to be concentrated to
cent. before it is marketable. This is accomplished by first passin
ore through a set of stamps, a stream of water then carries the cr
material on to a rubber belt about four feet wide, revolving at a
inclination, by which the heavier particles are carried under, t

gh, whilst the lighter portions pass off with the water. I
t that a great deal of the oxide must be lost, and also por-
ative metal. On examining some of the slime numerous
les of antimony could be seen. A large commodious build-
erected, wherein is stationed an 18 horse power engine.

NICKEL.

el Mine.—This mine is situated on the 6th lot in the 12th
rd. Mining operations have apparently been suspended
The general aspect on approaching the mine conveys some
directed enterprise of the proprietors. Numerous substan-
ve been erected, also a commodious store, powder-house,
ace, &c.—all now deserted, with the exception of one house,
retaker. This group of houses forms quite a village, and
ated in a more frequented locality, would in all probability
munerative than the mine.

shafts have been sunk on what appears to be a large
nclosing small transparent green crystals of chrome garnet,
netrated by long filaments of pyroxene, of a greenish or.
r. The latter mineral often occurs in long fibrous masses
great facility parallel to the fibres; it also assumes reticu-
the intervening parts being filled with dogtooth spar and

e-garnet also forms large granular masses, holding, spar-
inated, small brass-like grains and crystals of millerite.
rystals, however, are generally found penetrating a beau-
variety of calcite, and often exceed three inches in length.
of frequent occurrence in the massive portions of the
t, and are usually filled with small dodecahedrons of trans-
garnet and minute crystals of chromite.

GOLD.

Garthby.—An opportunity was taken to visit the so-called
the property of Mr. Elzear Deblois, marked on the town
the 15th range of Garthby.

ising specimens of native gold in a ferruginous-looking
ionally holding some cubical pyrites, are shown by the
ho assured me they were taken from a vein at the back of
n examining the vein, it was found to be highly crystal-
ng many modified forms of quartz. It was not visibly
d it also presents other points of difference, with the
own as coming from it.

GRAPHITE.

On the south half of lot 7, in the 1st range of Wakefield, a
granular variety of graphite occurs, filling pockets in a fine-gra
crystalline limestone.

The residents of the neighborhood are in the habit of using the c
material for polishing purposes. Whether this can be extracte
advantage must be decided by a trial. The outcrop, which is a
two feet, dipping at a high angle, does not present any encoura
feature, although there is every reason to suppose the mineral is d
buted to some extent throughout the entire band. This might e
be proved by a short adit level. A serpentinous mineral, which
probably be referred to rensselaerite, forms lenticular patches in
same band, and like the limestone is also graphitic, although in
instance, in broad scales.

A mineral, probably aragonite, occurs in connection with this
stone. It stands out in relief on the weathered surface, and consis
conical groups of long fibres, weathering to a yellowish-brown co

ASBESTUS.

This mineral is now causing some excitement in the Eastern T
ships, augmented by the gradual increasing demand for it.

There appear to be unlimited quantities of it distributed throug
the entire serpentine belt, which attains its greatest prominen
the townships of Thetford and Coleraine. The existence of asbest
generally made apparent by the whitish shining substance found co
the serpentine arising from the decay of the outcropping veins. Bu
must not be taken as always indicating the presence of workable v
The serpentine may be devoid of asbestus for several feet adjo
other masses intersected by numerous veins of it. Asbestus vein
apparently confined to certain masses, through which they p
parallel courses. Not unfrequently two small veins are seen to conv
into one.

At the Thetford mines, and elswhere, there are large blocks o
pentine without a trace of asbestus.

The veins are occasionally associated with grains of magnetit
chromic iron. Cobbing is then resorted to as the best means of se
tion. The magnetite forms rather conspicuous masses betwee
veins of asbestus in King's mine in Thetford, and sometimes it ent
replaces the latter.

Boston Company's Mine.—At the Boston Asbestus Packing Comp
mine, on the 27th lot in the 5th range of Thetford, I was informe
Mr. Sheridan, the company's Manager, that although the output

pectations, the demand was much greater than they could features at this and the neighbouring mines are very assive serpentine, varying in color from a dark green to cut by numerous veins of chrysotile (Asbestus) from a inch to four inches in width, which are comparatively eign matter.

ed in the month of August, this mine was about seventy covered a great deal of ground. About seventy-five tons bestus were awaiting shipment to Boston. A portion of in, that could not weigh less then two hundred pounds, up.

daily output during the summer months, was two tons. nen employed.

ine.—This mine situated on the 27th lot in the 6th range ownship, has been opened by a trench of about fifty yards not only affords ample gang-way room, but also serves purposes. In cutting this trench a wedge shaped mass ock was encountered in the serpentine. As at the last men- the work is progressing most favourably, and when fty men employed had raised ready for shipment about of first class asbestus. The daily output averages about

.—King Bros. mine is situated on the 26th lot in the 5th s of Thetford. This mine had commenced operations, me previous to my visit. The veins near the surface are fibres of crysotile are much broken by small penetrat- magnetite. They, however, seem to improve in depth y and size. Twenty men are employed, whose aggregate would amount to half a ton. Twenty tons have been ex- re ready for shipment.

.—This mine is situated on the south half of lot 27, in of the same township. A gang of twelve men has just perations, but owing to the necessity of procuring a por- the railroad track, were not making much progress.

ne.—This mine recently opened, is situated in the town- own. It was not visited, but I learned that about four extracted. Twenty men being employed. The average s about one quarter of a ton.

Pond.—This mine, situated on Big Island, in Lake Nicolet, hip of South Ham, is the property of Mr. W. Russell, of serpentine rocks at this point rise rather abruptly to seventy feet, forming cliffs on the western side of the

Several openings have been made at the most promising poi revealing in every case, veins of asbestus or crysotile in more or abundance. The mineral on this island, presents many point difference, both in quality and extent, with that from the townshi Thetford and elsewhere, and may be said to comprise four varieties

First. Small veins rarely exceeding half an inch in width, the fi not easily separable. This, however, does not detract from its c mercial value.

Second. Apparently occupying a position at right angles to veins above noticed, is a coarse fibrous mineral, resembling rope, evidently derived from the associated picrolite. The extreme le which these fibres may attain could not be determined, but jud from exposed portions it cannot be less then three feet.

Third. Veins somewhat resembling the latter in aspect, but m finer in texture. The fibre can be separated with great facility, tho firmly attached at one end to the parent rock.

Fourth. A steatitic asbestus rock, resembling "Mountain Leatl forms important masses, enclosing small concretionary pellet asbestus, the centres of which contain a nucleus of serpentine. little has yet been done on the island, to develop these asbestus v perhaps, owing to the difficulty of transport across the lake, wl however, would probably be more then counterbalanced by the ma ficent returns, this locality promises to afford.

APATITE.

The prospect of apatite mining cannot be said to be on the dec and a trip through the apatite region will soon dispel any doubt this respect, that rumour may have given rise to. Apatite lands are in great demand, and although exhorbitant prices are often offe they are nevertheless refused. The importance of this industr the Gatineau district, is daily becoming more apparent, and the struction of the Gatineau Valley railroad will, by affording transport render it still more profitable.

I had time to visit only a few of the productive mines in the t ships of Templeton, Hull and Wakefield. These will be referr separately.

Haldanes Mine.—This mine is situated on the 12th lot in the range of Wakefield, but was not visited. Specimens from it given me, some of which were of a dark green granular variety, much impregnated with iron pyrites, while the granular variety lighter shade contained no pyrites.

Moore's Mine.—This mine is situated on the 17th lot in the 1st r of Wakefield, on the property of Mr. Thos. Lawlor, the mining r

d by Mr. Isaac Moore of Ottawa. Nothing appears to
one to develop the apatite on this lot, with the exception
pecting, exposing a few small veins; one about four feet
eatly mixed with pyroxene and crystals of tourmaline.

ine.—This mine is also the property of Mr. Isaac Moore,
d on lot eighteen, range two of the same Township. At this
ost vertical stratum has been stripped for about fifty feet
ike, exposing numerous veins and pockets of apatite in
d limestone. The veins hold fine crystals of black mica, often
by crystals of pyroxene of 50 lbs. weight, with their
l lateral planes well preserved, although somewhat dulled
ent decomposition. An interesting vein of about two feet
at this mine, filled with crystals of apatite varying in size
nce to several hundred pounds. In following the vein, a
g was struck, with an entrance of five feet, the overhanging
vered with long handsomely formed crystals of pyroxene.
etween these crystals are best accounted for, by an exam-
e material forming the floor of the cave, and which consists
ted particles of apatite and an occasional crystal of pyroxene,
the decomposition of the apatite rock.

rds from this cave in a depression where the rocks become
ntal, several pits have been sunk with very satisfactory
what appear to be bedded masses of apatite alternating
ocks, as pyroxene and a translucent variety of scapolite. In
, a vein of quartz was seen cutting the stratification with
apatite and pyroxene.

tons of apatite had been mined, and was ready for shipment.
of my visit, the average daily output with nine men em-
four tons.

ce learned that two hundred tons more have been extracted,
total 230 tons for the year 1882.

ed masses are generally of the fine granular variety,
veins are sometimes filled with the coarser varieties.

ine.—This mine is situated on lot 17, range 2, of Wakefield.
vein of apatite has been followed about 40 feet. It is about
e, with a tendency to pinch out, in which case a bed of
ooking apatite, running with the stratification, may become
hough the removal of the overlying rocks would be attended
mount of labour and expense.

e from the vein consists of two varieties, the cleavable and
, varying in color from a bright red to a dull green. The
e latter variety are so strongly coherent as to admit being

mined and shipped with less loss than some of the varieties known sugar phosphate.

When visited in September about one hundred tons of first quali apatite had been taken out and were ready for shipment. Eight m were employed in the mine.

Moore's Mine.—This mine also belongs to Mr. Isaac Moore. It situated on lot 12, range 16, of Hull. Several openings have be made at various points on this lot, the result of which was not a nature to encourage further investment. The aggregate output the several pits might possibly amount to 30 tons. The veins of apat that were noticed were usually very small, sometimes intermingl with pyroxene.

Crystals of apatite are also abundantly interspersed throughout t pink calcite veins that intersect the rocks of the neighborhood. T overlying rock at this mine consists of orthoclase, studded with imp fect crystals of titanite and pyroxene, having a thickness of about feet.

In connection with the above may be mentioned a band of pink li stone, occurring a short distance east of the apatite openings, enclosi fine crystals of a greenish-black hornblende, sometimes three inches length and an inch in diameter. Immediately overlying this is anotl band of whitish limestone holding disseminated plates of graphite.

Close to the last mentioned place a small pit has been sunk, for wl purpose, I am unaware, revealing several feet of scapolite, apparen forming a bedded mass. The associated crystals, although attaining immense size, are usually very much defaced.

Apatite Mine.—On lot 7, range 7, of Templeton, a pit has been su through an orthoclase rock, studded with crystals of titanite, striki a bedded mass of apatite, presenting a 15 feet face and still not limit The apatite for the most part is a coarse cleavable variety, often v much impregnated with pyrites. Veins of calcite may be seen cutti the stratification, holding rounded crystals of pyroxene and apat Scapolite and hornblende, are also of frequent occurrence, fill cavities.

About 50 yards east of this opening another has been made, in wl appears to be a bed of greyish-white scapolite rock of considera thickness, cut by small veins of apatite, and there are also pocket a lamellar variety of pyroxene and apatite, which are somewhat c spicuous. Over one hundred tons of very fine apatite had been mi and were ready for shipment. Four men were employed in the mi

Post's Mine.—This mine is situated on the east half of lot 9, range of Templeton. The opening visited consists of a trench about 50 f

m 30 to 70 feet in width. The amount of apatite that has
as not ascertained, as all work was suspended.

ing the dumps, the mineralogical characters of the rock
r to differ from those shewn by many of the other apatite
th the exception of the occurrence of chabazite and
former in semi-transparent penetrating twins, and the
ish-white mamillated groups, the individuals of which are
rent. I have since learned Mr. Post is carrying on opera-
east, but with what success has not been ascertained.

e Mine.—This mine is situated on the west half of the same
rises a number of openings, the most extensive of which is
n descending the slope to the mine, the eye is at once
he numerous veins and patches that intersect the standing
ny of them crossing the stratification.

he associated minerals at this mine may be mentioned a
yrites, often enclosing grains of apatite, and in one instance
pyrites completely enveloped a crystal of apatite. Mr.
ompany's manager, presented me with some interesting
apatite, of a dark bottle-green color. They were in
rounded crystals, shewing deep indentations or cavities.
obably derived from some of the calcite veins.

e of my visit about twenty men were employed, and the
would aggregate about 100 tons. At another opening on
vn as the Spring Mine, a beautiful variety of sea-green
but to what extent this has been worked I failed to learn.

line.—This mine is situated on the south half of lot 10, in
ge of Templeton. At the time of my visit work had been

have been sunk, at various depths, in the pyroxene strata,
nent on the same would be a superfluous repetition of the
already given.

hick calcite vein was cut in one of the pits. It holds large
a, often two feet square, and perfectly free from cracks or
of this mineral have been subjected to the heat of an
stove, for three months, without any perceptible swelling
ut their transparency is slightly marred owing to their
ged by the flame. This vein may yet become of economic

-A beautiful pink translucent scapolite was noticed amongst
om the mines. It appears to assume this color only
as freshly fractured specimens are colorless.

Laurin's Property.—This property is situated on the south
in the 12th range of Templeton. The pyroxenic rocks

crop out in many places on this lot, and are occasionally cut by vei pink calcite, holding prisms of mica and of apatite. The more worl deposits, however, are confined to veins in the pyroxene, which very much in width. It is the intention of Mr. A. McLauren to mence operations in the fall.

Breckin's Mine.—This mine is situated on the 23rd lot, in the range of Templeton. At the time of my visit work was suspended owing to other exposures in the neighborhood, affording more encou ing prospects. The apatite, visible, occurs in spurs and small l cular patches, and may prove more abundant at a lower l The associated minerals noticed were titanite in large imperfect cry scapolite, prehnite, pyroxene, fluorite, idocrase, natrolite (?) and zi

Blue Apatite.—On the south half of lot 7, in the 1st range of W field, small sky-blue crystals of apatite occur, associated with prisn silvery mica, in a disintegrated limestone.

BARITE.

Barite.—Barite occurs on lot 12 in the 12th range of Templeton. small opening has been made in a gneissic rock, on, what is prob a bedded vein of a lamellar variety of barite. The upper po of the deposit, is greatly mixed with calcite, also, occasionally brownish red geniculated crystals of rutile, which mineral appea be more frequent, in a yellowish brown barite, that occurs near t overlying gneiss.

A small quantity of the mineral has been taken out, and consist the most part of an admixture of calcite and barite, constituting a inferior article. These impurities are less frequent in the lower po of the bed.

GARNET.

Garnet Mine.—An opening has been made in a band of crysta limestone, situated on the north half of lot six, in the first rang Wakefield, and better known as McBryde's Mine; crystals of Ga of various modifications, from the dodecahedron to the elong trapezohedron, occur in some abundance, also in clusters and talline aggregates of undeterminable form, from almost colo to white, and from translucent to opaque. One of the most mon forms being that of a rhombic dodecahedron of a hair b color. The lateral planes sometimes measuring two inches, an inch and a half in diameter.

These crystals are associated with zinc-blende, galena, py idocrase and graphite. The pyrite often forms a considerable pro tion of the whole mass.

ine.—Another opening has been made on lot fourteen of ge of the same township, where work, I am told, has been r four months, but with what object in view, I failed to he rock is a very crystalline limestone, interbedded with ollastonite. This latter mineral being sometimes interh the limestone forming granular masses, enclosing rude wine colored garnet of large dimensions: their structure granular, and they shatter under the least concussion, equently useless for ornamental purposes.

-These crystals are accompanied by large translucent ns of idocrase, often two inches in length, and one inch in ith their angles more or less bevelled.

ite.—Wollastonite also occurs on the south half of lot seven range, filling a vein with a sky blue calcite, and a mineral idocrase.

—Tremolite in reticulating masses of a light green color, t seventeen of the first range of Wakefield, enclosed in a . The bladed individuals are often semi-transparent, and ted longitudinally. They are accompanied by crystals of

—Scapolite may be mentioned in the same connection forming some thickness, the unweathered surfaces of which are h crystals of the same mineral. Although the faces are ough, owing to partial decomposition, their crystalline ect.

-To enumerate all the localities where titanite occurs th endless and useless. Suffice it to say, it is one of the only associated minerals of the apatite rocks, either dis- crystals or forming lamellar and granular masses in

ven in the first range of Wakefield, it occurs in crystals in nce as to make up more than three-fourths of the whole even the remainder is sometimes thickly studded with tals. The titaniferous mass is again cut by calcite veins, with crystals of titanite. More perfect crystals, however, similar circumstances about two hundred yards north of lace, of a clove brown color, and often measuring three s.

Mines.—Since writing the foregoing, I have been furnished details respecting this flourishing mine, owned by Messrs. Sons, of Aylmer, and on their authority the following based :

e now sixteen openings on veins of apatite, traceable from twenty to 100 feet across the lot; their width varies from two to ten feet. Among the most promising exposures that have been worked, may be mentioned a vein of red apatite, ten feet in width which has been stripped for a distance of forty-two feet, and tested to the depth of fifteen feet. Another opening known as the "Big Pit" has been sunk 125 feet, and has yielded since it was first opened about 1,800 tons of dark greenish apatite. The vein in the bottom of the mine is said to shew as well as ever.

A number of other veins in the neighborhood of the Big Pit mine, have afforded several hundred tons of a pale green apatite. About 100 yards south of the "Big Pit" mine, another opening has been made on a vein of red apatite, from which about eighty tons of 86½ per cent. phosphate have been extracted. A tunnel has been driven about sixty feet following a vein of blueish green apatite, from which 100 tons have been taken.

Messrs. Haldane expect to have 600 tons ready for shipment in the spring. Fifteen men are employed in connection with the mines. And during the four years of possession, twenty-five acres of land have been cleared and some substantial buildings erected.

GEOLOGICAL SURVEY OF CANADA.
ALFRED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR.

CHEMICAL CONTRIBUTIONS
TO THE
# GEOLOGY OF CANADA.
FROM THE
LABORATORY OF THE SURVEY.

BY

G. CHRISTIAN HOFFMANN, F. Inst. Chem.
Chemist and Mineralogist to the Survey.

PUBLISHED BY AUTHORITY OF PARLIAMENT.

Montreal:
DAWSON BROTHERS.
1883

C. Selwyn, Esq., LL.D., F.R.S., F.G.S.,

Director of the Geological and Natural History Survey and Museum.

ave the honor of herewith laying before you my Report
rk carried out in the Laboratory of this Survey during the
It embodies only such analyses and examinations as were
ly to prove of general interest. Of these, such as were
y Assistant Chemist, Mr. Frank D. Adams, have, in all
een duly credited to him.

ts of an examination of a series of coals, from the North-
ry, is in course of progress, and I trust to be in a position
the results, in the form of a separate report, at an early

I have the honor to be,
Sir,
Your obedient servant,
G. CHRISTIAN HOFFMANN.

December 30, 1882.

CHEMICAL CONTRIBUTIONS
TO THE
# LOGY OF CANADA.
FROM THE
LABORATORY OF THE SURVEY,
BY
CHRISTIAN HOFFMANN, F. Inst. Chem.

MISCELLANEOUS MINERALS.

SAMARSKITE.

Samarskite from Berthier county, P.Q.

esting mineral—not hitherto met with in Canada—was yond the north-western limits of the township of Brassard, erthier, P.Q.

d of irregular-shaped fragments without the slightest indica- alline form. Lustre, sub-metallic, shining. Color, brownish- t black; in parts iridescent. Opaque even on the thinnest tle. Fracture, uneven. Streak, greyish-brown. Hardness, ises between 4 and 4·5. Specific gravity, 4.9478. In the ecrepitates and gives off a little slightly acid water. Readily ely decomposed by heating with concentrated sulphuric sis gave:—

Analysis of.

bic acid. lic Acid..	55.41*
stic Acid	—
ic acid	.10
m oxide†	14.34
n oxides†	4.78
um oxide (UO_3)	10.75
nous oxide	.51
s oxide	4.83
	5.38
sia	.11
	.39
	.23
ne	trace.
	2.21
	99.04

---

in great part, if not almost entirely, columbic acid.

e or absence of other members of this group was not ascertained.

A gramme of the finely pulverized mineral, decomposed by he
with sulphuric acid, with careful exclusion of air, decolorize
amount of potassium permanganate corresponding to 4.79 per
ferrous oxide. The water was expelled by ignition and collecte
chloride of calcium tube.

INDURATED CLAY.

Indurated clay from Manitoba.

From Souris City, Souris River, Manitoba.

Structure, compact. Color, light bluish-grey. Lustre, dull. Sn
but meagre to the touch. Adheres strongly to the tongue. Tough.
what sonorous. Hardness, about 3. Fracture, irregular, occasi
imperfectly large conchoidal. May be ground, with tolerable fa
to a soft impalpable powder, which forms with water a more o
plastic paste. Geological position, Cretaceous—(Pierre formation.

This specimen was collected by Dr. A. R. C. Selwyn, who at th
of handing it to me expressed the opinion that it would, in all
bility, prove an excellent material for the manufacture of bu
brick; a supposition, the correctness of which has been fully bor
by actual experiment.

For the purpose of brick making, this material requires—agr
with the present experience—no admixture whatever. In the foll
experiments it was simply ground to powder—which it readily
of—mixed into a stiff paste with water, well pugged and then the
ing of the bricks proceeded with. By employing the material in
state of division, and forming the bricks under pressure, an article
close texture may be ensured. The bricks after having been thor

Its adaptability for the manufacture of building and fire brick.

dried, were finally burned in the muffle of a cupelling furnac
full-red heat. On examination they were found to have retaine
form well, having neither warped nor cracked; they were fir
tough; the color, a very pleasing one, may, perhaps, be best des
as a very pale brownish-yellow. They were in no wise affect
protracted and repeated immersion in water.

Other of these bricks were inserted in covered crucibles, and
latter placed in an air-furnace, the temperature of which was gra
raised, until, at the expiration of an hour, a white heat had been att
at which temperature it was maintained for an additional two
On opening the crucible the bricks were found to have retaine
original form intact, they had neither warped nor cracked, thei
remained perfectly sharp and showed no indication of having und
even the most incipient fusion. Color, a very pale reddish-brow

The foregoing experiments tend to show that this clay is well a
for the manufacture of an excellent building brick, and further,

nce, that it could also be advantageously employed for the re of a good class of fire brick.

l be stated that this material is readily accessible, and occurs lly unlimited quantity.

ysis of this clay, and further experiments in regard to its nt as a refractory material, will be carried out in the course nplated early investigation bearing directly upon the subject -clays.

TUMINOUS SAND-ROCK AND MINERAL-TAR OR MALTHA.

Bituminous sand-rock and mineral-tar from the North-west Territory.

ie Athabasca or Elk River—North-west Territory. With o the geological position and general mode of occurrence of Dr. R. Bell informs me:—

he deposit is of Cretaceous age, but rests directly upon of the Devonian system. The bedding of the latter undulates ile the asphaltic sand lies in thick horizontal layers upon its d in some cases fills fissures in the upper part of the lime-ie asphaltic matter has no doubt resulted from petroleum out of the underlying Devonian rocks, in which evidence of nce can be detected. In descending the Athabasca River it observed a few miles above the junction of the Clearwater

Mode of occurrence.

low which it becomes more conspicuous, forming the whole he stream, with the exception of a few feet of limestone at the distance of many miles. These banks are sometimes about ed and fifty feet in height, and frequently maintain an eleva-bout one hundred feet for considerable distances. Except y have been long exposed to the weather, they generally look coal. A thick tar is often seen draining out of the deposit, nerous places on the ground at the foot of either bank, or on wer than their summits, this tar collects in pools, or flows n streams to lower levels among the peaty materials in the he surface of these accumulations of tar is usually covered dened pitchy crust. The boatmen on the river break through in order to collect the underlying tar which they boil down r pitching their craft. Some parts of the banks are rendered *nasse* from being over-saturated with the asphalt, and in warm ey slide gradually down into the bed of the river incorporat-ulders and pebbles in their course."

BITUMINOUS SAND-ROCK.

Bituminous sand-rock.

e Athabasca River, about six miles below its confluence with ater. Collected by Dr. R. Bell. This specimen was compact

Bituminous sand-rock, cont.

and homogeneous in appearance, and of a dull, dark brownish- color. Specific gravity at at 60° F. 2.040. At the temperature of it is quite firm, barely, if at all, yielding to pressure, and does n the hand; at 70° F. it gives somewhat to the touch, and is sl sticky; at 100° F. it becomes quite soft and eminently soils the fi It is scarcely acted on by alcohol in the cold, and but very slightl boiling temperature; but ether, oil of turpentine, kerosene, b (petroleum spirit), benzol (coal-tar naphtha) and bi-sulphide of c more especially the last two named, readily dissolve the bitum matter, with formation of dark brown colored solutions, and lea pure or almost pure siliceous residue in the form of sand, of whi parently the bitumen had constituted the sole binding medium.

Analysis of.

The composition of this specimen of the rock was found to follows:—

Bitumen	12.42
Water, mechanically included	5.85
Siliceous sand	81.73
	100.

The sand consisted of colorless transparent quartz, not unfreq presenting the bright glassy lustre of broken quartz crystal, the su were, however, for the most part, more or less dulled by abrasi contained a few flakes of silvery mica, and, as Mr. Adams—to w handed a small quantity for microscopical examination—informs occasional fragment of felspar. It is on the whole exceedingly f per cent. of the same passing a sieve of ninety meshes to the inch; 16 per cent. one of seventy-five meshes; 15 per cent. sixty-six meshes, and 9 per cent. one of fifty meshes, leaving a b of 8 per cent. as rejected by the latter.

Subsequent to the foregoing examination Mr. A. S. Cochrane, o survey, handed me a specimen which he collected, and which from the above, in that it does not appear to contain so much and the bituminous matter partakes more of the nature of asphal the temperature of 65 F. it is quite hard, fragments may be chip with a hammer, and it is reducible in a mortar to a non-cohere verulent condition; at 100° F. it barely yields to pressure, and i slightly adhesive: at 150° F. it gives to the touch and is som sticky; at 200° F. it is quite soft, and may be readily moulded.

MALTHA OR MINERAL-TAR.

Maltha or mineral-tar

From the right bank of the Athabasca, about twelve miles bel confluence with the Little Red River. Collected by Mr. A. S. Coc ial also occurs at several other points further down the dentical with that referred to in the prefatory remarks.

in question had a pitchy-black color, in thin layers and d light, rich dark reddish-brown. The specific gravity at und to be 1.023; at this temperature it has the consistence ct, and will barely flow; at 70° F., flows, but sluggishly, F. it has the consistence of treacle.

Economic uses of the Bituminous sand-rock.

the utilization of these substances,—the most appropriate the former and that for which it would appear to be admir- would be for asphalting purposes. It has one of the most lifications of a good bituminous concrete, viz., intimate f the mineral and organic constituents, and this in a degree icial preparation of the kind could be expected to possess. probability be found, that a very slight treatment will ren- for employment in the construction of roads, foot-paths, *cetera;* for asphalting the flooring of granaries, basements and the like, and further as a roofing material. Should more expedient to separate the bitumen, this may be mply boiling or macerating the material with hot water, uminous matter, entering into fusion, will rise as a scum and may be removed by skimmers, whilst the sand falls to the vessel.

Extraction of the Bitumen.

ent was made in order to ascertain the greatest state of h the bitumen could be brought by this method; it was f the 81.73 per cent. sand, 69.26 per cent. had been extracted bitumen containing 50.1 per cent. sand, and— extreme fineness of a portion of this latter, as already may be questioned if the purification, by this method, d much beyond this.

parated by this process, when carefully conducted, is t free from bitumen, and might, after being heated to reverberatory furnace—to destroy any little adhering dvantageously employed for the manufacture of one of lities of glass.

reatment requires but the simplest of appliances and ily carried out on the spot.

Economic uses of the Maltha.

of maltha at my disposal was far too small to warrant t its distillation. Should it occur in sufficient quantity, bly, amongst other uses, be advantageously employed as al for the manufacture of illuminating and lubricating in.

NATURAL WATERS.

Lake and river waters from North-west Territory.

The following lake and river waters from the North-west Terri were collected at the instance of Mr. A. S. Cochrane, whilst condu a survey in the section of country in question, and handed to m him for examination.

Mr. Frank D. Adams has conducted a qualitative analysis of waters, and also estimated the amount of total dissolved solid m contained in them. The results obtained by him were as s below.

Examination of water from Reindeer Lake.

1.—Reindeer Lake.—This water was taken from an open space bet the islands, about ten miles above the outlet of the lake. Da collection, July 25th, 1881.

There was a small quantity of flocculent suspended matter yellowish-brown color. After filtration the water had a brownish-yellow tinge. The specific gravity at 15.5° C. was f to be 1000.04, and the total dissolved solid matter dried at 10 amounted to 2.02 grains to the Imperial gallon.—It containe

Potassa and soda	A very small quantity, potassa predominating
Lime	A slight trace.
Magnesia	A trace.
Silica	A very small quantity.
Carbonic acid	A mere trace.
Chlorine	A trace.

Examination of water from Churchill River.

2.—Churchill or English River.—This sample was taken from centre of the river, about six miles above the Kettle Falls. of collection, July 28th, 1881.

There was a large quantity of flocculent suspended matter light brown color. After filtration the water had a pale brow yellow tinge. Its specific gravity at 15.5° C., was 1000.17. total dissolved solid matter—dried at 100° C.,—amounted to grains per Imperial gallon.—It contained :

Potassa and soda	A rather large quantity, potassa predominatin
Lime	A small quantity.
Magnesia	A very small quantity.
Silica	A somewhat large amount.
Carbonic acid	A very small quantity.
Chlorine	A small quantity.

Examination of water from Saskatchewan River.

3.—Saskatchewan River.—Taken from the centre of the river, ab quarter of a mile below the junction of the Big-Stone River. of collection, August 3rd, 1881.

Examination of water from Saskatchewan River.

re was a large amount of brownish-black colored flocculent · in suspension. After filtration, the water had a pale ish-yellow color. The specific gravity at 15.5° C., was found 1000.33, and the total dissolved solid water—dried at 100° mounted to 16.60 grains per Imperial gallon.—It contained :

otassa and soda....	A rather large quantity, potassa preponderating.
ime..............	A large quantity.
agnesia	A rather large quantity.
errous oxide......	A trace.
lica	A somewhat large amount.
ılphuric acid.....	A somewhat large amount.
rbonic acid......	A large amount.
hlorine...........	A very small quantity.

he foregoing waters that from the Reindeer Lake, is remark- r the small amount of dissolved solid matter which it con- in this regard it would take rank with the waters of Bala Merionethshire, Wales, and Loch Katrine, Perthshire, Scot- he former of which contains 1.953 grains (Frankland and), and the latter 1.981 grains (Wallace) of solid matter to llon.

IRON ORES.

HÆMATITE.

Iron ores—Analyses of

ear the head of Loch Lomond, a quarter of a mile north- f the L'Ardoise road, and a quarter of a mile south-west of ars road, Cape Breton county, Nova Scotia. Mr. Hugh er informs me that it is a contact deposit, and the geological n, Lower Carboniferous.

Hæmatite from near Loch Lomond, Nova Scotia.

cture, compact. Color, steel-grey, in parts red. Determin- —by Mr. Frank D. Adams—of the more important con- ts, gave the following results:

Ferric oxide..................................	83.645
Ferrous oxide.................................	7.640
Manganous oxide...............................	.285
Phosphoric acid...............................	.077
Sulphuric acid................................	.194
Water, hygroscopic............................	.341
Insoluble residue.............................	7.768
Metallic iron, total amount of................	64.494
Phosphorous...................................	.034
Sulphur.......................................	.078

ld this deposit prove at all extensive, and the ore equal in · to the above sample, it cannot fail to prove of importance.

MAGNETITE.

Iron ores—Analyses of, cont.

2.—A specimen of magnetite from the thirteenth lot of the sixth of Bagot, county of Renfrew, Ontario, was examined by D. Adams, and found to contain:

Magnetite from county of Renfrew, Ont.

Metallic iron	45.87
Titanium dioxide	trace
Insoluble residue	28.56

The object of the enquiry did not call for a more ext examination.

He has also examined samples of magnetite from other lo ranges—in this township, in order to ascertain if they con titanium dioxide or no, and with the following results: spec from lot five, and the east half of lot ten of the twelfth ran also a specimen from the twelfth lot of the seventh range, found to be quite free from the same.

Magnetite from Thunder Bay, L.S.

3.—A very fine crystalline, dark steel-grey colored magnetite location seven, Thunder-Bay, Lake Superior, was found to co

Metallic iron	49.02
Insoluble residue	24.61

This specimen was perfectly free from titanium dioxide.

Magnetite from county of Frontenac, Ont.

4.—Magnetic iron ore from the seventeenth lot of the eleventh of the township of Olden, county of Frontenac, Ontario.

Massive, structure, coarse-crystalline. Color, greyish- lustre, metallic. A partial analysis gave as follows:

Ferric oxide	68.146
Ferrous oxide	28.975
Water, hygroscopic	.059
Insoluble residue	1.364
Metallic iron, total amount of	70.238

This specimen was perfectly free from titanium dioxide.

CLAY IRON-STONE.

Clay iron-stone from North-west Territory.

The following seven specimens of clay iron-stone from the west Territory, were collected by Dr. G. M. Dawson, by they were submitted to me for examination, accompanied b following notes in regard to their geological position and g mode of occurrence, in that section of country. He says:

Clay iron-stone from North-west Territory—General mode of occurrence of

ay be stated generally, that iron-stone occurs in greater or
ndance at all horizons of the Cretaceous and Laramie or
ion beds, whether of marine or fresh water origin, through-
North-west Territory.

ithstanding this general distribution, however, no locality
rved is capable of yielding this ore in such great quantity
tify a belief in its immediate commercial value.

ron-stone occurs either in nodular masses, following certain
f the shales, sandy-clays and clays of the formations above
to, or in more or less regular nodular sheets intercalated
the beds. To those localities in which a considerable
of iron-stone bearing bands occur in proximity in a
e thickness of beds, the greatest importance attaches, and
of these it may eventually be proved profitable to work
entire banks for their extraction. The analyses so far
nd to shew the high position which these iron-stones hold
res of the same class, both as to percentage of iron and
from injurious elements.

e Pierre shales exposed in Pembina Mountain and its
the iron-stone so far discovered is of inferior quality,
ore is not abundant. Further west, in the Lignitic (Fort
formation of the Souris region, iron-stone is much more
t and often occurs on the surface in large quantities,
has been left as the soft containing beds were denuded

region drained by the South Saskatchewan and its tri-
, the Pierre shales contain a much larger proportion of
e than they do in their eastern exposures, and in some
ay yet prove to hold deposits of economic importance.
s 5 and 8 of the present series of analyses are of ore
from this subdivision of the Cretaceous, the former occurr-
odules of large size and in considerable abundance in
banks on the Bow River, the latter in the immediate
of the main coal seam on the Belly River, but in a layer
w inches thick. Number 7 is also probably from this
and occurs forming a series of beds each a few inches in
s, which are intercalated in black shales in such great
as to form a considerable proportion of the whole. The
is near the mouth of Kananaskis River, a short distance
Bow River fall. Specimen number 9 is from a series of
dstones and sandy clays which underlie the Pierre shales,
ain in some exposures very large quantities of iron-stone
remarkable from their great size and septarian character.

Clay iron-stone from North-west Territory—Analyses of

The iron-stone of this subdivision of the Cretaceous was observed to be most abundant in the high scarped banks between the mouth of the St. Mary's River and Coal Banks on the Belly River. Numbers 10 and 6 are derived from a series of beds, the precise stratigraphical position of which is yet open to some doubt. They contain estuarine fossils, and occasionally many large nodules and nodular sheets of iron-stone. The locality on the Bow River from which the specimen numbered 6 was collected, is one of those which appear most promising; here the iron-stones are very abundant and often several tons in weight. The stratigraphical position of the specimen numbered 11, is uncertain, owing to the extreme disturbance which the beds in the immediate vicinity of the mountains have suffered "

From Bow River.

5.—Bow River, eight miles above Grassy Island.

Structure, very fine granular. Color, ash-grey with a brownish tinge. Streak, ash-grey. Fracture, imperfectly conchoidal. Weathers purplish-brown.

A partial analysis of this ore gave:

Ferrous oxide	40.347
Ferric oxide	.878
Water, hygroscopic	.856
Insoluble residue	16.121
Metallic iron, total amount of	31.996

From Bow River.

6.—Bow River, twelve miles above Prairie Island.

Structure, compact. Color, ash-grey. Streak, pale ash-grey. Fracture, large conchoidal. Weathers, reddish-brown.

A partial analysis of this specimen gave:

Ferrous oxide	28.818
Ferric oxide	.818
Water, hygroscopic	.938
Insoluble residue	13.935
Metallic iron, total amount of	22.987

From Kananaskis River.

7.—Kananaskis or Rapid River, near its confluence with Bow River.

Structure, very fine granular. Color, dark bluish-grey. Streak, dark-grey. Fracture, imperfectly conchoidal. Weathers, brownish-red.

Clay iron-stone from North-west Territory—Analyses of, cont.

artial analysis gave:

Ferrous oxide	13.786
Ferric oxide	.772
Water, hygroscopic	.473
Insoluble residue	66.966
Metallic iron, total amount of	11.263

River, at "Coal Banks."

From Belly River.

cture, very fine granular. Color, brownish-grey. Streak, ey with a slight brownish tinge. Fracture, imperfectly oidal.

artial analysis gave:

Ferrous oxide	41.458
Ferric oxide	.328
Water, hygroscopic	1.042
Insoluble residue	10.294
Metallic iron, total amount of	32.475

River, about seven miles below "Coal Banks."

From Belly River.

cture, fine granular. Color, pale reddish-brown. Streak, ish-grey. Fracture, irregular. Weathers, dark reddish-

rtial analysis gave the following results:

Ferrous oxide	30.730
Ferric oxide	1.398
Water, hygroscopic	1.272
Insoluble residue	23.754
Metallic iron, total amount of	24.880

From Belly River.

River, about seventeen miles east of the mouth of the Little iver.

cture, compact. Color, pale brownish-yellow. Streak, light Fracture, large conchoidal. Weathers, brownish-yellow.

rtial analysis of this specimen gave:—

Ferrous oxide	30.302
Ferric oxide	1.487
Water, hygroscopic	1.445
Insoluble residue	12.120
Metallic iron, total amount of	26.165

From Mill Creek.

reek, at coal outcrop, about four miles above the mill.

cture, fine granular. Color, dark grey. Streak, ash-grey.

Fracture, irregular. Weathers dark reddish-brown. A pa analysis of this specimen gave :—

Ferrous oxide	37.985
Ferric oxide	.811
Water, hygroscopic	.634
Insoluble residue	22.511
Metallic iron, total amount of	30.112

MANGANESE ORES.

Manganese ores—Analyses of.

1.—From the Glenmore or Morrison mine, Salmon-River road, a two miles east of the head of Loch Lomond, Cape Breton co Nova Scotia.

Pyrolusite from near Loch Lomond, Nova Scotia.

This specimen consisted almost exclusively of pyrolusi partial analysis of the same—after drying at 100° C.—afforde F. D. Adams, the following results :—

Manganese dioxide	91.84	per cent.
Ferric oxide	.12	" "
Insoluble residue	2.91	" "

Bog manganese from Boularderie Island, Nova Scotia.

2.—Bog Manganese, from the vicinity of Big Harbour, Boular Island, Cape Breton, Nova Scotia. The deposit is stated to extensive one.

This sample was in the form of porous friable lumps, varyi color from dark-brown to brownish and bluish black. A p analysis, by Mr. F. D. Adams, gave the following results :—

Manganese dioxide	25.42	per cent.
Water	33.52	" "

Judging from specimens, collected in previous years, from locality, I am disposed to regard the one in question as a picke not an average sample of this deposit.

GOLD AND SILVER ASSAYS.

The following assays were all conducted by Mr. Frank D. *Adam*

PROVINCE OF NOVA SCOTIA.

Gold and Silver assays.

1.—From a large brook, a little above the Salmon River road, miles from the head of Loch Lomond, and six miles from Mi

The specimen, a single fragment, weighed four and a half ou it consisted of a breccia through which was disseminated gale

finely divided state: the galena apparently constituted but
proportion of the whole. Assays gave .—

Gold and Silver assays, cont.

Gold	None.
ilver	2.879 ounces to the ton of 2,000 lbs.

Province of Nova Scotia.

oad, nine and three quarter miles west of Canso, Guys-
h county, Cape Breton.
sample weighed a little over four pounds; it consisted of an
ion of copper pyrites, arsenical pyrites and iron pyrites in
e of greyish, translucent quartz. It was found to contain :—

Gold	trace.
Silver	0.379 ounce to the ton of 2,000 lbs.

ecimen was taken from an opening about two hundred feet
from that of the preceding specimen.
nsisted of mispickel associated with a small quantity of a
translucent quartz.
It contained only traces of gold and silver.

PROVINCE OF NEW BRUNSWICK.

Province of New Brunswick.

ee River, Gloucester county.
specimen, a single fragment, weighed somewhat over three
uarter pounds, and consisted of a coarsely crystalline galena,
ed with copper pyrites and a small quantity of zinc blende,
ngue of greyish, subtranslucent quartz—the latter consti-
19.8 per cent. by weight of the whole. Assays gave :—

Gold	trace.
Silver	7.197 ounces to the ton of 2,000 lbs.

the so-called "Nigadoo Silver-mine," Gloucester county.
e crystalline galena, associated with a little zinc blende, in
or less weathered rocky gangue. The metallic sulphides
ted but a small proportion of the whole. It contained :—

Gold	trace.
Silver	5.811 ounces to the ton of 2,000 lbs.

PROVINCE OF ONTARIO.

Province of Ontario.

a small island in the Ottawa River. near Fitzroy Harbour,
ip of Fitzroy, Carleton county.
arsely crystalline galena, associated with a trifling amount
te. It was found to contain :—

Gold	none.
Silver	0.493 ounce to the ton of 2,000 lbs.

Gold and Silver assays, cont.

7.—Another specimen found in close proximity to the foregoing, likewise a coarsely crystalline galena, but of a much darker color than the generality of specimens of this mineral; gave an assay:—

Province of Ontario.

Gold.... .... None.
Silver................. 0.751 ounce to the ton of 2,000 lbs.

8.—From Hastings county.

The specimen, which weighed thirteen and a half pounds, consisted for the most part of a coarsely crystalline aggregate of quartz felspar and mica, carrying a little iron pyrites; the lesser portion consisted of a more or less weathered, finely granular, highly quartzoze schist.

It contained neither gold nor silver.

9.—From near the Duncan Mine, W½B, Thunder Bay, Lake Superior.

A greyish siliceous rock carrying small quantities of galena and zinc blende, and a little iron pyrites; the metallic sulphides constituting but a very small proportion of the whole. This sample was found to contain:—

Gold... None.
Silver........... ...... 0.343 ounce to the ton of 2,000 lbs.

10.—From location 20, township of McIntyre, Thunder Bay, Lake Superior.

A coarsely crystalline calcite, associated with quarts, and carrying small quantities of zinc blende and galena, with here and there a speck of copper pyrites.

It contained neither gold nor silver.

11.—From Pie Island, Lake Superior.

A very finely crystalline galena associated with a little zinc blende, in a gangue consisting of quartz and a highly siliceous rock; the metallic sulphides constituted but a small proportion of the whole. It contained:—

Gold............................. .... distinct trace.
Silver.................2.249 ounces to the ton of 2,000 lbs.

12.—From the same locality as the foregoing.

It consisted of finely crstalline galena associated with zinc blende, in a gangue of similar composition to that of the foregoing specimen. It was found to contain:—

Gold... None.
Silver................. 0.343 ounce to the ton of 2,000 lbs.

Gold and Silver assays, cont.

13.—From the same locality as No. 11.

It consisted of zinc blende in a gangue closely resembling that of the two previous specimens. The zinc blende constituted about one-third, in bulk, of the sample; it contained precisely the same amount of silver as the preceding specimen, viz: 0.343 ounce to the ton of 2,000 lbs.

NORTH-WEST TERRITORY.

North-west Territory.

14.—This and the three following specimens came from the Rocky Mountains, western part of the district of Alberta.

This specimen consisted of an impure reddish-grey coloured dolomite.

It contained neither gold nor silver.

15.—An impure reddish-grey coloured fine granular quartzite, with which was associated a small quantity of galena. It contained:—

Gold	None.
Silver	0.466 ounce to the ton of 2,000 lbs.

16.—Consisted for the most part of copper pyrites, associated with more or less green and blue carbonate of copper. Assays gave:—

Gold	0.364 ounce to the ton of 2,000 lbs.
Silver	28,619 " " " "

17.—This specimen consisted of chalcocite, more or less seamed and coated with green carbonate of copper.—A valuable copper ore.—It contained neither gold nor silver.

MISCELLANEOUS EXAMINATIONS.

The following determinations were carried out by Mr. Frank D. Adams:—

Miscellaneous examinations.

Estimation of zinc in blende from White Sand River, L.S.

1.—Zinc. According to Dr. R. Bell, an extensive deposit of sphalerite occurs nine miles and a half north of the mouth of White Sand River, which latter enters Lake Superior opposite to Simpson's Island, and consequently about the middle of the north shore of the lake.

A specimen from this locality was found to contain:—

Zinc	54.26 per cent.

Estimation of nickle and cobalt in pyrrhotite from Pie Island, L.S.

2.—Nickel and cobalt. A specimen of pyrrhotite—associated with a little chalcopyrite and sphalerite, with a small quantity of intermingled chlorite—from Pie Island, Lake Superior, was found—after drying at 100° C.,—to contain:—

Nickel	0.562 per cent.
Cobalt	0.138 "

Miscellaneous examinations, cont.

Estimation of nickel and cobalt in pyrrhotite from St. Stephen, N.B.

3.—Nickel and Cobalt. A mineral specimen from Mr. Thompso
farm, St. Stephen, Charlotte county, New Brunswick. This c
sisted of pyrrhotite in association with chalcopyrite and a lit
magnetite, in a gangue of greenish-grey serpentine; the pyrrhot
constituted approximately about one-fourth by weight of the who
The pyrrhotite carefully freed from the associated minerals w
found—after drying at 100° C.,—to contain :—

Nickel..	0.923 per cent.
Cobalt..	0.394 "

Estimation of phosphoric acid in trap from Black Cape, P. Q.

4.—A highly decomposed trap from Black Cape, New Richmon
Bonaventure county, P.Q.—was examined for, and found to co
tain, an amount of phosphoric acid, equal to 0.594 per cent.
tribasic phosphate of lime.

Date Due

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